EPA/ROD/R08-91/045
1991

EPA Superfund
Record of Decision:

CHEMICAL SALES CO.
EPA ID: COD007431620
OU 01
DENVER, CO
06/27/1991

Text:
JUNE 27, 1991
REGIONAL ADMINISTRATOR
EPA REGION VIII

#SNLD
I. SITE NAME, LOCATION AND DESCRIPTION

THE CHEMICAL SALES COMPANY (CSC) SUPERFUND SITE IS LOCATED IN COMMERCE CITY, COLORADO AND IN THE NORTHERN PORTION OF DENVER, COLORADO, APPROXIMATELY FIVE MILES NORTHEAST OF DOWNTOWN DENVER. THE SITE IS DIVIDED INTO THREE OPERABLE UNITS.

OU1: THIS OPERABLE UNIT (OU) INCLUDES THE CSC PROPERTY AND ADDRESSES SOIL AND GROUNDWATER CONTAMINATION SOUTH OF SAND CREEK. IT IS APPROXIMATELY BOUNDED BY FOREST STREET TO THE WEST; I-70 TO THE SOUTH; MONACO PARKWAY TO THE EAST; AND SAND CREEK TO THE NORTH AS SHOWN IN FIGURE 1. THIS OU IS ALSO REFERRED TO IN THIS ROD AS THE LEYDEN STREET LOCATION AND/OR LEYDEN STREET SITE.

OU2: THIS OU ADDRESSES GROUNDWATER CONTAMINATION GENERALLY DOWNGRADIENT OF OU1. IT IS APPROXIMATELY BOUNDED BY QUEBEC STREET TO THE EAST; HOLLY STREET TO THE WEST; SAND CREEK TO THE SOUTH; AND EAST 86TH AVENUE TO THE NORTH (SEE FIGURE 1). THE BOUNDARIES FOR OU1 AND OU2 ARE DEFINED BY THE APPROXIMATE EXTENT OF GROUNDWATER CONTAMINATION (FIGURE 2). IF CONTAMINANTS WITHIN THE GROUNDWATER CONTINUE TO MIGRATE, THE BOUNDARIES OF CSC OU1 AND OU2 WILL CORRESPONDINGLY EXPAND.

OU3: THIS OU COVERS THE SAME AREA AS OU2 BUT ADDRESSES RESIDENTIAL EXPOSURE TO CONTAMINANTS THROUGH DOMESTIC USE OF ALLUVIAL GROUNDWATER.

THE SUBJECT OF THIS RECORD OF DECISION (ROD) IS CSC OU1. THIS OU INCLUDES THE CSC PROPERTY LOCATED AT 4661 MONACO PARKWAY IN DENVER, COLORADO. THE TOPOGRAPHY WITHIN OU1 SLOPES NORTHWARD TOWARD SAND CREEK. ELEVATIONS RANGE FROM 5,200 FEET NEAR SAND CREEK TO 5,265 FEET ABOVE MEAN SEA LEVEL (AMSL) IN THE SOUTHEASTERN CORNER OF OU1. NATURAL TOPOGRAPHIC FEATURES HAVE BEEN EXTENSIVELY MODIFIED BY CONSTRUCTION AND EARTHWORK. A RELATIVELY ABRUPT CHANGE IN THE NATURAL TOPOGRAPHY OCCURS AS A TERRACE IN THE VICINITY OF EAST 48TH AVENUE, WHERE THERE IS AS MUCH AS A 50 FOOT CHANGE IN ELEVATION TO THE NORTH. THIS SLOPE ROUGHLY PARALLELS EAST 48TH AVENUE FROM LEYDEN STREET, AND THEN PARALLELS THE CHICAGO, ROCK ISLAND AND PACIFIC RAILROAD (FIGURE 3). THE NORTHERN PORTION OF OU1 LIES WITHIN THE SAND CREEK FLOODPLAIN. SAND CREEK, WHICH FORMS THE NORTHERN BOUNDARY OF OU1, IS THE PRIMARY DISCHARGE POINT FOR DRAINAGE DITCHES IN OU1. APPROXIMATELY THREE MILES DOWNSTREAM (NORTHWEST OF OU1), SAND CREEK ENTERS THE SOUTH PLATTE RIVER.

TWO DRAINAGE DITCHES WERE IDENTIFIED IN THE SOUTHERN PORTION OF OU1. THE DRAINAGE DITCH NEAR THE CSC SITE (LOCATED ON THE NORTHERN PORTION OF CSC PROPERTY) DRAINS THE CSC PROPERTY NORTH OF THE CSC WAREHOUSE AND TANK FARM. THE OTHER DITCH ORIGINATES AT A CULVERT BENEATH THE CHICAGO ROCK ISLAND AND PACIFIC RAILROAD AND TERMINATES AT A CULVERT AT THE INTERSECTION OF MONACO PARKWAY AND EAST 48TH AVENUE.

THE PROPERTY LOCATED ADJACENT TO THE WESTERN BOUNDARY OF THE CSC PROPERTY IS OWNED BY THE INTERSTATE DISTRIBUTION CENTER ASSOCIATES (IDCA), LTD. THE TRAMMELL CROW COMPANY ACTS AS AN AGENT FOR IDCA. THE FIGURES OF THIS ROD TEXT REFER TO THE BUILDING CONSTRUCTED ON THE IDCA PROPERTY AS THE "TRAMMELL CROW" BUILDING. PRIOR TO THE PREPARATION AND CONSTRUCTION OF THIS BUILDING AT 4650 LEYDEN ST., A DRAINAGE SWALE EXISTED WHICH PROVIDED SURFACE DRAINAGE FROM THE CSC PROPERTY. THIS DRAINAGE SWALE EXTENDED FROM JUST SOUTH OF THE CSC TANK FARM ACROSS WHAT IS NOW THE IDCA PROPERTY.

GROUNDWATER WITHIN CSC OU1 FLOWS NORTHWARD INTO CSC OU2. GROUNDWATER IN THE CSC OU2 AREA IS THE PRINCIPAL SOURCE OF DOMESTIC DRINKING WATER FOR THE SOUTH ADAMS COUNTY WATER AND SANITATION DISTRICT (SACWSD). SACWSD SUPPLIES WATER TO APPROXIMATELY 30,000 CUSTOMERS. THE MAJORITY OF THE SACWSD MUNICIPAL WATER SUPPLY IS DERIVED FROM THE ALLUVIAL AQUIFER. A TOTAL OF SIX ALLUVIAL AQUIFER PRODUCTION WELLS ARE CURRENTLY IN USE WITHIN OU2.

THE LAND USE WITHIN OU1 IS LARGELY INDUSTRIAL. SIX RESIDENCES ARE LOCATED IN THE NORTHERN PORTION OF OU1. ONE RESIDENCE IS LOCATED ON EAST 50TH AVENUE AND THE OTHERS ARE LOCATED ON EAST 52ND AVENUE. ALL OF THE RESIDENCES WITHIN OU1 ARE CONNECTED TO THE SACWSD SYSTEM.

RAILROAD SPURS LOCATED TO THE NORTH AND SOUTH OF THE CSC WAREHOUSE SERVICE THE CSC. CHEMICALS ARE TRANSPORTED IN BULK TO THE CSC FACILITY BY TRAIN AND ARE UNLOADED ALONG THESE RAILROAD SPURS.

MOST OF THE OU1 POPULATION CONSISTS OF WORKERS WHO COMMUTE FROM OUTSIDE OU1 TO JOBS IN THE OFFICE AND WAREHOUSE BUILDINGS. OTHER THAN THE FEW RESIDENCES IN THE NORTHERN PORTION OF OU1, THE PREDOMINANT LAND USE CONSISTS OF COMMERCIAL OFFICES AND WAREHOUSES, WITH A GRAVEL MINING OPERATION ALONG SAND CREEK IN THE NORTHERNMOST PORTION OF OU1.

PAST AND PRESENT SURFACE AND SUBSURFACE STORAGE UNITS AND OTHER STRUCTURES ON THE CSC OU 1 PROPERTY INCLUDE SEVERAL UNDERGROUND AND ABOVE GROUND CHEMICAL STORAGE TANKS AND DRUMS. THE SIZE OF THESE TANKS RANGES FROM 5,000 TO 15,000 GALLONS, AND THEY CONTAIN A VARIETY OF ORGANIC CHEMICALS AND ACIDS. SEVERAL UNDERGROUND TANKS HAVE BEEN REMOVED FROM THE CSC PROPERTY. THE CSC STORAGE TANKS ARE LOCATED ALONG THE WESTERN BOUNDARY OF THE CSC PROPERTY (FIGURE 4).

#SHEA
II. SITE HISTORY AND ENFORCEMENT ACTIVITIES

INITIAL INVESTIGATIONS

IN 1981, THE ENVIRONMENTAL PROTECTION AGENCY (EPA) CONDUCTED A RANDOM NATIONAL SURVEY OF DRINKING WATER SYSTEMS. DURING THIS SURVEY, SEVERAL ORGANIC CHEMICALS WERE DETECTED IN SACWSD ALLUVIAL MUNICIPAL WATER SUPPLY WELLS. ADDITIONAL SAMPLING IN 1982 AND 1985 CONFIRMED THESE RESULTS. AS A RESULT OF THESE FINDINGS, EPA BEGAN A RI/FS FOR AN AREA NAMED THE "OFF-POST ROCKY MOUNTAIN ARSENAL (RMA) OU1" (OFF-POST RMA OU1). THIS AREA EXTENDED FROM SAND CREEK TO THE SOUTH; EAST 80TH AVENUE TO THE NORTH; THE SOUTH PLATTE RIVER TO THE WEST; AND THE WESTERN BORDER OF THE RMA TO THE EAST. THE RI/FS WAS COMPLETED IN DECEMBER 1986. THE RI RESULTS CONSISTENTLY INDICATED WIDESPREAD CONTAMINATION BY CHLORINATED VOLATILE ORGANIC COMPOUNDS IN GROUNDWATER ALONG THE EASTERN PORTION OF THE STUDY AREA. THE SELECTED ALTERNATIVE WAS A PERMANENT WATER TREATMENT SYSTEM FOR SACWSD WATER. A RECORD OF DECISION WAS SIGNED IN JUNE 1987 WHICH IMPLEMENTED THE CONSTRUCTION OF THE KLEIN TREATMENT PLANT, WHICH BEGAN OPERATING IN OCTOBER 1989. IN ADDITION, APPROXIMATELY 400 RESIDENTS WITHIN THE CSC OU2 SITE WERE CONNECTED TO SACWSD.

THE ADJACENT RMA WAS SUSPECTED AS ONE OF THE SOURCES OF GROUNDWATER CONTAMINANTS IN THE FORMER OFF-POST STUDY AREA BECAUSE OF THE HISTORY OF WASTE DISPOSAL ON THAT SITE. FURTHER INVESTIGATION BY EPA INDICATED THAT ADDITIONAL SOURCE AREAS WERE POTENTIALLY CONTRIBUTING TO CONTAMINATION DETECTED WITHIN THE STUDY AREA.

IN APRIL 1986, THE EPA FIELD INVESTIGATION TEAM (FIT) CONDUCTED A SOIL GAS SURVEY OF A 65-ACRE AREA NEAR EAST 48TH AVENUE. ELEVATED TRICHLOROETHENE (TCE) VALUES WERE DISCOVERED ON THE NORTH SIDE OF THE

RAIL SPUR IN THE NORTHERN PORTION OF THE CSC PROPERTY. IN AUGUST 1986, EPA'S FIT INSTALLED MONITORING WELLS IN THE AREA WHERE ELEVATED SOIL GAS TCE VALUES WERE OBSERVED. THESE WELLS WERE SAMPLED BY THE FIT IN LATE AUGUST AND EARLY SEPTEMBER 1986. A FULL DESCRIPTION OF THESE FIELD INVESTIGATION ACTIVITIES AND A SUMMARY OF THE DATA OBTAINED THROUGH THESE EFFORTS ARE PROVIDED IN THE FOLLOWING REPORTS:

* SOUTH ADAMS SOIL GAS SURVEY (E&E 1986A)
* I-270 AND QUEBEC STREET (E&E 1986B)
* E. 48TH AVE. AND LEYDEN STREET (E&E 1986C)
* E. 50TH AVE. AND IVY STREET (E&E 1986D)
* E. 56TH AVE. AND MAGNOLIA (E&E 1987).

THE RESULTS OF THESE STUDIES INDICATED THE RELEASE OF HAZARDOUS SUBSTANCES INTO GROUNDWATER FROM THE CSC PROPERTY. AS A RESULT OF THIS FINDING AND SUBSEQUENT SCORING OF THE SITE BASED ON THE HAZARD RANKING SYSTEM (HRS), EPA PROPOSED THE CSC SITE FOR THE NATIONAL PRIORITIES LIST (NPL) IN JUNE 1988. THIS LISTING WAS FINALIZED IN AUGUST 1990.

EPA ISSUED THE CSC A SPECIAL NOTICE LETTER IN AUGUST 1988, REQUESTING THAT CSC CONDUCT A RI/FS FOR THE CSC SITE. CSC NOTIFIED EPA THAT THE COMPANY WOULD NOT UNDERTAKE THE RI/FS FOR THE ENTIRE CSC SITE. IN JUNE 1989, EPA SUBDIVIDED THE GROUNDWATER RI/FS ACTIVITIES INTO TWO SEPARATE OUS FOR THE CSC SITE (OU1 AND OU2) AND REQUESTED THAT CSC CONDUCT A RI/FS FOR OU1. IN AUGUST 1989, CSC SUBMITTED A GOOD FAITH OFFER TO EPA TO CONDUCT THE RI/FS FOR OU1. IN SEPTEMBER 1989, EPA AND CSC ENTERED INTO AN ADMINISTRATIVE ORDER (AO) ON CONSENT (DOCKET NO. CERCLA-VIII-90-03) REQUIRING CSC TO CONDUCT A RI/FS FOR CSC OU1.

AS A RESULT OF SITE CHARACTERIZATION ACTIVITIES CONDUCTED DURING THE OU1 RI/FS, HAZARDOUS SUBSTANCES IN THE FORM OF CHLORINATED VOLATILE ORGANIC COMPOUNDS WERE DETECTED IN SOILS WITHIN THE IDCA PROPERTY BOUNDARIES AT 4650 LEYDEN STREET (NOTED AS "TRAMMELL CROW" ON FIGURES). AS A RESULT OF THIS FINDING, EPA ISSUED GENERAL NOTICE TO IDCA IN OCTOBER 1990 NOTIFYING IDCA THAT IT WAS CONSIDERED A POTENTIALLY RESPONSIBLE PARTY (PRP) FOR THE CSC SUPERFUND SITE.

CHEMICAL SALES COMPANY OPERATIONS

IN 1962, A WAREHOUSE WAS CONSTRUCTED AT 4661 MONACO PARKWAY. BETWEEN 1962 AND 1976, THE WAREHOUSE WAS OCCUPIED BY SAMSONITE, AND THEN BY GATES RUBBER COMPANY. THESE COMPANIES REPORTEDLY USED THE FACILITY SOLELY AS A PRODUCT WAREHOUSE. CSC PURCHASED AND OCCUPIED THE FACILITY IN OCTOBER 1976. ALL EXISTING SURFACE AND UNDERGROUND STORAGE TANKS, PIPELINES, AND APPURTENANCES WERE INSTALLED BETWEEN OCTOBER 1976 AND FEBRUARY 1977.

THERE HAVE BEEN THREE REPORTED CHEMICAL RELEASES OF HAZARDOUS SUBSTANCES INTO THE SOIL AND GROUNDWATER AT THE SITE FROM THE CSC FACILITY. THE FIRST OCCURRED ON AUGUST 21, 1985, WHEN APPROXIMATELY 200 GALLONS OF METHYLENE CHLORIDE WERE RELEASED AS A RESULT OF A SPIGOT BREAKING OFF DURING CHEMICAL TRANSFER (COLORADO DEPARTMENT OF HEALTH, 1986A). THE SECOND RELEASE OCCURRED ON MARCH 28, 1986, WHEN CONTAMINATED RAINWATER IN THE TRANSFER PIPE GALLERY WAS DISCHARGED INTO A NEARBY DRAINAGE DITCH (COLORADO DEPARTMENT OF HEALTH 1986B). SAMPLING CONDUCTED BY THE COLORADO DEPARTMENT OF HEALTH INDICATED THAT METHYLENE CHLORIDE, CHLOROFORM, AND 1,1,1-TRICHLOROETHANE (1,1,1-TCA) WERE PRESENT IN THE DISCHARGE. THE THIRD RELEASE WAS A METHANOL SPILL WHICH OCCURRED ON MAY 9, 1990, WHEN APPROXIMATELY 3,700 GALLONS OF METHANOL WERE SPILLED ON THE GROUND SURFACE IN THE AREA OF THE CSC TANK FARM (FOSTER, 1990).

REMEDIAL INVESTIGATION/FEASIBILITY STUDY

AS STATED PREVIOUSLY, ON SEPTEMBER 29, 1989, AN AO ON CONSENT WAS ISSUED TO THE CSC REQUIRING THE COMPANY TO CONDUCT A RI/FS TO CHARACTERIZE THE NATURE AND EXTENT OF CONTAMINATION AND IDENTIFY AND EVALUATE ALTERNATIVES TO ADDRESS THE IDENTIFIED CONTAMINATION. THE REMEDIAL INVESTIGATION INCLUDED GEOPHYSICAL SURVEYS, DRILLING AND SAMPLING 45 SOIL BORINGS, INSTALLING AND SAMPLING 22 GROUNDWATER MONITORING WELLS, AND COLLECTING SIX SURFACE WATER SAMPLES.

THE RI/FS REPORT, COMPLETED IN FEBRUARY 1991, INDICATES THAT HAZARDOUS SUBSTANCES ARE PRESENT IN SOILS AND GROUNDWATER IN PORTIONS OF OU1. THE CONTAMINATED AQUIFER OF CONCERN IS A SHALLOW, UNCONSOLIDATED AQUIFER WHICH IS NOT PRESENTLY USED AS A DRINKING WATER SOURCE WITHIN OU1. THIS ALLUVIAL AQUIFER, HOWEVER, SUPPLIES DRINKING WATER FOR APPROXIMATELY 30,000 PEOPLE FURTHER DOWNGRADIENT IN THE CSC OU2 AREA. THE SOURCE AREAS CONTRIBUTING TO THE OBSERVED GROUNDWATER CONTAMINATION HAVE BEEN IDENTIFIED AS CONTAMINATED SOILS WITHIN THE PROPERTIES OWNED BY CSC (4661 MONACO PARKWAY) AND IDCA (4650 LEYDEN ST).

AS PART OF THE RI/FS, EPA PREPARED A BASELINE RISK ASSESSMENT (RA) IN OCTOBER 1989 TO ESTIMATE POTENTIAL HEALTH AND ENVIRONMENTAL RISKS WHICH COULD RESULT IF NO ACTION WERE TAKEN IN CSC OU1. THE RA INDICATED THAT EXPOSURE TO GROUNDWATER AND SOIL CONTAMINANTS AT THE CSC OU1 SITE COULD RESULT IN SIGNIFICANT UNACCEPTABLE RISKS TO PUBLIC HEALTH. DETAILS OF THE RA ARE SUMMARIZED IN SECTION VI OF THIS ROD.

#HCI
III. HIGHLIGHTS OF COMMUNITY INVOLVEMENT

COMMUNITY INTEREST IN THE GROUNDWATER CONTAMINATION IN SOUTH ADAMS COUNTY WAS VERY INTENSE IN 1985 AND EARLY 1986 WHEN THE PROBLEM FIRST BECAME PUBLIC. THE INITIAL BLAME WAS PLACED ON THE ROCKY MOUNTAIN ARSENAL, WHICH WAS ADJACENT TO THE CONTAMINATED PUBLIC WATER SUPPLY AREA AND ALREADY RECEIVING SIGNIFICANT MEDIA ATTENTION. LOCAL CITIZENS FORMED A VERY VOCAL GROUP CITIZENS AGAINST CONTAMINATION (CAC), WHICH HELD A NUMBER OF WELL ATTENDED PUBLIC MEETINGS (OVER 600 PEOPLE ATTENDED THE MARCH 6, 1986 MEETING). CAC KEPT THE ISSUE IN THE PRESS AND IN THE ATTENTION OF LOCAL, STATE, AND FEDERAL POLITICIANS. EPA AND THE ARMY RESPONDED TO NUMEROUS PUBLIC AND MEDIA INQUIRIES, ISSUED PRESS RELEASES FOR NEW DEVELOPMENTS, AND ATTENDED THE PUBLIC MEETINGS. COMMUNITY RELATIONS ACTIVITIES WERE COORDINATED AMONG THE EPA, THE ARMY, AND THE SOUTH ADAMS COUNTY WATER AND SANITATION DISTRICT (SACWSD). THE STATE CONDUCTED A SEPARATE PROGRAM.

PUBLIC INTEREST SUBSIDED IN MID-1986 AFTER A TEMPORARY WATER TREATMENT SYSTEM FUNDED BY THE ARMY AND THE EPA CAME INTO OPERATION AT SACWSD AND WAS MADE AVAILABLE TO THE AFFECTED RESIDENCES. IN THE FALL OF 1986, EPA NAMED THE CHEMICAL SALES SITE AS A SOURCE OF GROUNDWATER CONTAMINATION. EPA HAS SINCE ISSUED A NUMBER OF FACT SHEETS DISCUSSING THE PROGRESS OF THE INVESTIGATION AND ACTIVITIES AT THE SITE. THE CHEMICAL SALES SITE WAS ALSO INCLUDED IN JOINT COMMUNITY RELATIONS ACTIVITIES WITH SEVERAL OTHER SOUTH ADAMS COUNTY SUPERFUND SITES.

THE PROPOSED PLAN FOR OU2 WAS ISSUED TO THE PUBLIC CONCURRENTLY WITH PROPOSED PLANS FOR OU1 AND OU3 ON FEBRUARY 25, 1991. THE PROPOSED PLAN AND RI/FS REPORTS WERE MADE AVAILABLE TO THE PUBLIC IN THE ADMINISTRATIVE RECORD MAINTAINED AT THE EPA REGION VIII SUPERFUND RECORDS CENTER IN DENVER, COLORADO. A NOTICE OF AVAILABILITY FOR THESE DOCUMENTS WAS PUBLISHED IN THE DENVER POST AND ROCKY MOUNTAIN NEWS ON FEBRUARY 28, 1991; IN THE COMMERCE CITY BEACON FEBRUARY 27, 1991; AND IN THE COMMERCE CITY EXPRESS ON MARCH 5, 1991. THE PUBLIC COMMENT PERIOD

WAS OPEN FROM FEBRUARY 28 TO APRIL 1, 1991. THE PUBLIC MEETING WAS HELD MARCH 14, 1991 AT THE COMMERCE CITY RECREATION CENTER. A TRANSCRIPT OF THE PUBLIC MEETING IS INCLUDED IN THE ADMINISTRATIVE RECORD. AT THIS MEETING, EPA REPRESENTATIVES ANSWERED QUESTIONS ABOUT THE SITE AND DISCUSSED THE REMEDIAL ALTERNATIVES UNDER CONSIDERATION. RESPONSES TO COMMENTS RECEIVED DURING THE PUBLIC COMMENT PERIOD ON THE PROPOSED PLAN ARE PRESENTED IN THE RESPONSIVENESS SUMMARY SECTION OF THIS ROD.

#SCOP
IV. SCOPE AND ROLE OF OPERABLE UNIT WITHIN SITE STRATEGY

THE CSC SUPERFUND SITE HAS BEEN DIVIDED INTO THREE OUS. OU1 ADDRESSES THE SOURCE AREA LOCATED IN THE VICINITY OF THE CSC PROPERTY AND GROUNDWATER CONTAMINATION SOUTH OF SAND CREEK. OU2 ADDRESSES THE GROUNDWATER PLUME EMANATING FROM OU1 AND OTHER GROUNDWATER CONTAMINATION LOCATED NORTH OF SAND CREEK. OU3 ADDRESSES RESIDENTIAL EXPOSURE TO CONTAMINATED ALLUVIAL GROUNDWATER THROUGH USE OF DOMESTIC PRIVATE WELLS AND DOMESTIC WATER SUPPLIED BY THE SACWSD.

THE REMEDY SELECTED IN THIS ROD IS FOR OU1. THIS REMEDY ADDRESSES THE CONTAMINATED SOIL ON THE CSC AND IDCA PROPERTY AND CONTAMINATED GROUNDWATER SOUTH OF SAND CREEK EMANATING FROM THESE PROPERTIES. THE GROUNDWATER POSES AN UNACCEPTABLE RISK TO HUMAN HEALTH AND THE ENVIRONMENT DUE TO INGESTION, AND INHALATION DURING SHOWERING, OF CONTAMINANTS IN GROUNDWATER ABOVE EXISTING OR PROPOSED MAXIMUM CONTAMINANT LEVELS (MCLS) AS ESTABLISHED BY THE SAFE DRINKING WATER ACT OR EXCEEDING THE (10-6) RISK LEVEL. DUE TO HIGH CONCENTRATIONS OF PCE, AND OTHER SOLVENTS, THERE IS A STRONG POSSIBILITY THAT POOLS AND POCKETS OF LIQUID PCE OR OTHER SOLVENTS ARE PRESENT AT THE SITE. THESE CONTAMINANTS IN THEIR LIQUID FORM ARE CALLED DENSE NON-AQUEOUS PHASE LIQUIDS (DNAPLS). IF DETECTED, THEY WILL PRESENT A SOURCE OF GROUNDWATER CONTAMINATION AND THUS A "PRINCIPAL THREAT" TO PUBLIC HEALTH AND THE ENVIRONMENT.

CONTAMINATED GROUNDWATER IN CSC OU1 MIGRATES NORTHWARD INTO OU2. A REDUCTION IN THE MASS OF CONTAMINANTS WITHIN OU1 WILL RESULT IN A SUBSEQUENT REDUCTION IN CONCENTRATION OF CONTAMINANTS IN GROUNDWATER WITHIN THE OU2 AREA.

IN ADDITION, SURFICIAL SOILS POSE AN UNACCEPTABLE RISK THROUGH INGESTION AND INHALATION OF CONTAMINANTS ASSOCIATED WITH CONTAMINATED SOILS.

#SC
V. SITE CHARACTERISTICS

SITE GEOLOGY AND HYDROLOGY

THE NORTHERN PORTION OF OU1 (NORTH OF EAST 48TH AVENUE) LIES WITHIN THE SAND CREEK FLOOD PLAIN, WHICH IS PART OF THE SOUTH PLATTE RIVER SYSTEM. THE TOPOGRAPHY, DISTRIBUTION OF SURFICIAL DEPOSITS, AND THE MATERIALS ENCOUNTERED DURING DRILLING SUGGEST THAT THE SOUTHERN PORTION OF OU1 (SOUTH OF 48TH AVENUE) IS A TERRACE COMPRISED OF SLOCUM ALLUVIUM BENEATH EOLIAN SAND, SILT AND CLAY. THE TERRACE WAS MOST LIKELY FORMED BY RENEWED DOWNCUTTING OF THE SAND CREEK TRIBUTARY OF THE SOUTH PLATTE RIVER.

THE ALLUVIAL AQUIFER BELOW OU1 IS GENERALLY COMPOSED OF FINE TO COARSE, POORLY SORTED SANDS AND OCCASIONAL GRAVELS CONTAINING SILT AND CLAY. NORTH OF EAST 48TH AVENUE, THE AQUIFER APPEARS TO BE COMPOSED OF COARSER GRAINED SAND AND GRAVEL COMPARED TO THE AREA SOUTH OF EAST 48TH AVENUE.

THE ALLUVIAL AQUIFER IS UNDERLAIN BY SHALE, SILTSTONE, AND SANDSTONE OF

THE DENVER FORMATION. THE BEDROCK SURFACE OF THE DENVER FORMATION REFLECTS THE EROSIONAL DEVELOPMENT OF THE SOUTH PLATTE RIVER VALLEY, AND IS CHARACTERIZED BY ISOLATED BEDROCK HIGHS AND PALEOCHANNELS. IN GENERAL, THE BEDROCK SURFACE EXHIBITS A REGIONAL NORTHWARD SLOPE, WITH MAXIMUM ELEVATIONS OCCURRING IN THE SOUTHERN PORTION OF OU1 AND MINIMUM ELEVATIONS IN THE NORTHERN PORTION OF OU1 (FIGURE 5). AS ILLUSTRATED IN FIGURE 5, A PALEOCHANNEL MAY BE PRESENT WITHIN OU1, TRENDING NORTH-NORTHWESTWARD TOWARD SAND CREEK.

DEPTHS TO GROUNDWATER BENEATH OU1 GENERALLY DECREASE FROM SOUTH TO NORTH TOWARD SAND CREEK. THE DECREASED DEPTH TO WATER TOWARD THE NORTH CORRESPONDS TO AN INCREASE IN SATURATED THICKNESS. FIGURE 6 ILLUSTRATES THE SATURATED THICKNESS OF THE ALLUVIAL AQUIFER.

THE WATER TABLE SHOWN IN FIGURE 7 INDICATES THAT THE ALLUVIAL GROUNDWATER FLOWS IN A NORTHERLY TO NORTHWESTERLY FLOW DIRECTION. BECAUSE OF THE INCREASE IN THE PRESENCE OF COARSER-GRAINED SAND AND GRAVEL FROM SOUTH TO NORTH, THE ALLUVIAL GROUNDWATER VELOCITY INCREASES THREE-FOLD NORTH OF EAST 48TH AVENUE. SOUTH OF EAST 48TH AVENUE, THE GROUNDWATER FLOW VELOCITY IS ESTIMATED TO BE APPROXIMATELY 1 FEET/DAY. NORTH OF EAST 48TH AVENUE, THE GROUNDWATER FLOW VELOCITY IS ESTIMATED TO BE APPROXIMATELY 10 FEET/DAY.

SAND CREEK DOES NOT ACT AS A BARRIER TO NORTHWARD GROUNDWATER MIGRATION. THIS DETERMINATION IS BASED ON THE (1) DETECTION OF CONTAMINANTS IN GROUNDWATER NORTH OF SAND CREEK, (2) LACK OF DETECTION OF CONTAMINANTS IN SAND CREEK (BASED ON DATA COLLECTED FOR THE SAND CREEK INDUSTRIAL RI (1988)) AND (3) THE OCCURRENCE OF UNNATURAL PERENNIAL DISCHARGES ASSOCIATED WITH THE AURORA WASTEWATER TREATMENT PLANT LOCATED UPSTREAM. THE ARTIFICIAL FLOWS PROBABLY EXCEED SAND CREEK'S BASE FLOW DURING MOST OF THE YEAR, AND THUS SOME PORTION OF ITS FLOW INFILTRATES TO THE UNDERLYING AQUIFER RESULTING IN DILUTION OF THE CONTAMINANT PLUME.

ADDITIONAL EFFORTS TO DETERMINE GROUNDWATER/SURFACE WATER INTERACTIONS IN THIS PORTION OF SAND CREEK HAVE INCLUDED GAUGING AND INSTALLATION OF PIEZOMETER NESTS, BUT THE RESULTS OF THOSE STUDIES WERE INCONCLUSIVE.

NATURE AND EXTENT OF CONTAMINATION

THE RI FOR CSC OU1 INCLUDED AN INVESTIGATION OF THE GROUNDWATER, SOILS, SURFACE WATER AND AIR MEDIA. BASED ON DATA COLLECTED DURING THESE INVESTIGATIONS, THE SURFACE WATER MEDIUM WAS DETERMINED NOT TO BE OF CONCERN WITH REGARD TO CONTAMINANT PATHWAYS AT THE SITE.

THE RI INVESTIGATORY ACTIVITIES WERE DIVIDED INTO THREE SEPARATE PHASES (PHASES I - III). DURING PHASE I, A SOIL GAS SURVEY AND GEOPHYSICAL SURVEY WERE CONDUCTED TO IDENTIFY POTENTIALLY CONTAMINATED AREAS REQUIRING FURTHER CHARACTERIZATION. SOIL BORINGS AND MONITORING WELLS WERE INSTALLED DURING PHASE II TO DETERMINE THE AREAL EXTENT OF SOIL AND GROUNDWATER CONTAMINATION. ADDITIONAL SOIL BORINGS AND MONITORING WELLS WERE INSTALLED IN PHASE III. AMBIENT AIR DATA WERE ALSO COLLECTED DURING THIS PHASE.

SOIL CONTAMINATION

FORTY-FIVE (45) SOIL BORINGS WERE INSTALLED DURING THE RI TO CHARACTERIZE THE NATURE AND EXTENT OF SOIL CONTAMINATION. SOIL HEADSPACE MEASUREMENTS WERE TAKEN FOR SOILS AT 5-FOOT DEPTH INTERVALS. MEASUREMENTS WERE BASED ON READINGS OF SOIL HEADSPACE MADE WITH A FIELD GAS CHROMATOGRAPH (GC). GAS CHROMATOGRAPH READINGS OF THE SOIL HEADSPACE WERE INITIALLY CONDUCTED AS A PRELIMINARY SCREEN TO DETERMINE THE PRESENCE OR ABSENCE OF CONTAMINANTS IN THE SOIL. DURING PHASE II

SOIL SAMPLING, APPROXIMATELY 30 PERCENT OF SOIL SAMPLES DISPLAYING SOIL GAS DETECTIONS WERE SUBMITTED FOR LABORATORY ANALYSIS. DUE TO ANALYTICAL DISCREPANCIES AND DIFFICULTIES ASSOCIATED WITH BOTH SOIL FIELD GC HEADSPACE ANALYSIS AND LABORATORY ANALYSIS OF SOIL, ALL SAMPLES REGISTERING SOIL HEADSPACE DETECTIONS WERE SUBMITTED FOR LABORATORY ANALYSIS DURING THE PHASE III INVESTIGATION.

RI INVESTIGATIONS INDICATED THE PRESENCE OF HAZARDOUS SUBSTANCES IN THE SOIL MEDIA IN THE VICINITY AND WITHIN THE PROPERTIES OWNED BY CSC AND IDCA. THE AREAL EXTENT OF SOIL CONTAMINATION BASED ON SOIL HEADSPACE GC MEASUREMENTS IS PRESENTED IN FIGURE 8. THE VERTICAL EXTENT OF THE SOIL CONTAMINATION BASED ON MEASUREMENTS IS PRESENTED IN FIGURE 9. CONTAMINATION IS PRESENT IN THE SOILS AND CAPILLARY FRINGE AREAS. (THE CAPILLARY FRINGE IS LOCATED BETWEEN THE WATER TABLE AND VADOSE ZONE). SOIL CONTAMINATION INDICATED BY THE LABORATORY ANALYSES IS PRESENTED IN FIGURE 10. THE CONTAMINATED AREAS OUTLINED IN THESE FIGURES REPRESENT THE SOIL ZONES CONTRIBUTING TO GROUNDWATER CONTAMINATION. DISCREPANCIES BETWEEN SOIL AND SOIL HEADSPACE DATA CAN BE ATTRIBUTED TO: (1) LACK OF ADEQUATE LABORATORY CONFIRMATION BY LABORATORY ANALYSIS OF SOIL SAMPLES DURING PHASE II SAMPLING; (2) LOSS OF VOLATILES PRIOR TO LABORATORY ANALYSIS OF SOILS DURING PHASE II SAMPLING; AND (3) DIFFICULTIES IN COMPARING CONCENTRATIONS OF CONTAMINANTS DETECTED IN THE SOIL VAPOR AND OF CONTAMINANTS BONDED TO THE SOIL (THROUGH A PROCESS REFERRED TO AS ADSORPTION); AND (4) LACK OF PRECISION AND ACCURACY OF SOIL HEADSPACE DATA.

EPA HAS DETERMINED THAT THE EXTENT OF SOIL CONTAMINATION REQUIRING REMEDIATION SHOULD BE BASED ON THE FIELD GC HEAD SPACE DATA AS DEPICTED IN FIGURE 8. FIELD GC HEAD SPACE DATA FOR CSC OU1 ARE MORE COMPREHENSIVE THAN LABORATORY DATA COLLECTED FOR THE SITE. IN ADDITION, THE POTENTIAL FOR LOSS OF VOLATILES PRIOR TO LABORATORY ANALYSIS WAS MINIMIZED FOR THE GC HEAD SPACE ANALYSES SINCE SAMPLES WERE ANALYZED IMMEDIATELY FOLLOWING SAMPLING.

CONTAMINANTS WERE DETECTED IN THE SURFICIAL SOIL, THROUGHOUT THE SOIL COLUMN, AND IN THE CAPILLARY FRINGE AREA. THIS CONTAMINATION IS THE PRINCIPAL SOURCE OF ALLUVIAL GROUNDWATER CONTAMINATION WITHIN OU1. POTENTIAL SOURCES OF THE OBSERVED SOIL CONTAMINATION INCLUDE: (1) ORGANIC SOLVENTS STORED AT CSC TANK FARM; (2) SURFACE DRAINAGE FROM THE CSC PROPERTY; (3) LEAKS AND SPILLS FROM RAIL CARS DURING UNLOADING OPERATIONS; AND, (4) RELEASES DURING CSC OPERATIONS. THE FOLLOWING CHEMICALS OF CONCERN (COCS) WERE DETECTED IN THE SOIL:

TETRACHLOROETHYLENE (PCE),
TRICHLOROETHYLENE (TCE),
1,1-DICHLOROETHYLENE (DCE),
CIS-1,2-DICHLOROETHYLENE (CIS-1,2-DCE),
1,1,1-TRICHLOROETHANE (TCA),
1,1-DICHLOROETHANE (DCA), AND
METHYLENE CHLORIDE.

A DESCRIPTION OF EACH OF THE FOUR SOURCE AREAS IS PROVIDED BELOW.

CSC TANK FARM

THE CSC TANK FARM IS LOCATED WITHIN THE WESTERN BOUNDARY OF THE CSC PROPERTY. CSC HAS STORED VARIOUS ACIDS AND ORGANIC SOLVENTS IN THIS AREA (SEE FIGURE 11 AND TABLE 1). THE TANK CONTENTS REPORTED IN TABLE 1 WERE CURRENT AS OF THE DATE OF THE FINAL RI REPORT (ENGINEERING SCIENCE, 1991). HIGH CONCENTRATIONS OF THE COCS HAVE BEEN DETECTED IN SOIL AND GROUNDWATER IMMEDIATELY NORTHWEST OF THIS AREA. HIGH SOIL-GAS DETECTIONS OF THE COMPOUNDS PCE, TCE, AND 1,1,1-TCA WERE ALSO OBSERVED IN THE SOUTHERN PORTION OF THE CSC TANK FARM. PCE HAS BEEN AND IS CURRENTLY BEING STORED ABOVEGROUND IN THE NORTHWESTERN PORTION OF THE

CSC SURFACE TANK FARM (PRESENTLY STORED IN TANK T-17, FIGURE 11).

SURFACE DRAINAGE OF THE CSC PROPERTY

PRIOR TO SITE PREPARATION FOR THE IDCA BUILDING (4661 LEYDEN ST.), A DRAINAGE SWALE EXTENDED FROM JUST SOUTH OF THE CSC TANK FARM ACROSS WHAT IS NOW THE IDCA PROPERTY (LEGAL MEMORANDUM ON THE DEFENSES TO LIABILITY OF IDCA, 1991). THIS SWALE POTENTIALLY PROVIDED A PATHWAY FOR RELEASES OF HAZARDOUS SUBSTANCES ON THE CSC PROPERTY. THE RAILROAD SPUR, NORTH OF THE TANK FARM, MAY POTENTIALLY HAVE CAUSED PONDING OF SURFACE DRAINAGE FROM THE CSC PROPERTY. SOIL CONTAMINATION HAS BEEN DETECTED IN CLOSE PROXIMITY TO THE SWALE AND SUSPECTED PONDING AREA.

RAILROAD SPUR

ANOTHER POTENTIAL PRIMARY SOURCE FOR THE IDENTIFIED SOIL AND GROUNDWATER CONTAMINATION IS THE RAILROAD SPUR IMMEDIATELY NORTH OF THE TANK FARM. CHEMICALS ARE DELIVERED TO CSC VIA THE RAIL SPUR, AND HAVE BEEN STORED IN RAIL CARS PARKED ON THE SPUR. LEAKS AND SPILLS DURING UNLOADING OPERATIONS COULD HAVE CONTRIBUTED TO THE CONTAMINATION AT THAT LOCATION. PCE, 1,1,1-TCA, AND OTHER CHEMICALS ARE TRANSFERRED DIRECTLY FROM RAIL CARS INTO THE SURFACE TANKS VIA FILL PIPES AND HOSES. SOIL AND GROUNDWATER CONTAMINATION HAS BEEN DETECTED IN THE VICINITY OF THE RAILROAD SPUR NORTH OF THE CSC TANK FARM.

RELEASES DURING CSC OPERATIONS

SEVERAL DOCUMENTED RELEASES OF HAZARDOUS SUBSTANCES HAVE BEEN REPORTED RESULTING FROM CSC OPERATIONS. ON AUGUST 21, 1985, APPROXIMATELY 200 GALLONS OF METHYLENE CHLORIDE WERE RELEASED. ON MARCH 28, 1986, CONTAMINATED RAINWATER IN THE TRANSFER PIPE GALLERY WAS DISCHARGED INTO A NEARBY DRAINAGE DITCH. ADDITIONALLY, ON MAY 9, 1990, 3700 GALLONS OF METHANOL WERE SPILLED ON THE GROUND SURFACE IN THE AREA OF THE CSC TANK FARM. SEVERAL RELEASES OF ACID FUMES HAVE ALSO BEEN REPORTED. ON FEBRUARY 13, 1990, THE DENVER FIRE DEPARTMENT RESPONDED TO AN ACID RELEASE REPORTED FROM CSC PROPERTY. THE FIRE DEPARTMENT EVACUATED WORKERS FROM NEARBY BUILDINGS, INCLUDING 4650 LEYDEN, AND TREATED SEVERAL WORKERS FOR THE INHALATION OF ACID FUMES. THREE ADDITIONAL RELEASES OF ACID FUMES HAVE BEEN REPORTED AND INVESTIGATED BY THE DENVER FIRE DEPARTMENT. THESE RELEASES OCCURRED ON THE FOLLOWING DATES: AUGUST 2, 1990; SEPTEMBER 11, 1990; AND FEBRUARY 16, 1991.

GROUNDWATER CONTAMINATION.

DURING THE REMEDIAL INVESTIGATION, 36 GROUNDWATER MONITORING WELLS WERE SAMPLED AND ANALYZED FOR VOLATILE ORGANIC COMPOUNDS, SEMI-VOLATILE ORGANIC COMPOUNDS, TOTAL AND DISSOLVED METALS, AND ANIONS. AS A RESULT OF THIS EFFORT, A GROUNDWATER CONTAMINANT PLUME WAS IDENTIFIED IN THE ALLUVIAL AQUIFER, EMANATING FROM THE CSC AND IDCA PROPERTIES. THE DIRECTION OF CONTAMINANT MIGRATION IS TO THE NORTH-NORTHWEST. THE FOLLOWING COCS HAVE BEEN IDENTIFIED FOR THE GROUNDWATER MEDIUM:

PCE,
TCE,
1,1,1-TCA,
1,1-DCE,
1,1-DCA,
CIS-1,2-DCE,
VINYL CHLORIDE,
METHYLENE CHLORIDE, AND
CARBON TETRACHLORIDE.

GROUNDWATER DATA COLLECTED FOR THE COCS DURING THE RI ARE PROVIDED IN

TABLE 2. THE DATA INDICATE THE PRESENCE OF HIGH CONCENTRATIONS OF VOLATILE ORGANIC COMPOUNDS (VOCS) IN THE GROUNDWATER BENEATH THE CSC AND IDCA PROPERTIES AND IN AN AREA APPROXIMATELY THREE HUNDRED FEET NORTHWEST OF THE CSC TANK FARM. PCE HAS BEEN DETECTED AT CONCENTRATIONS AS HIGH AS 30 PARTS PER MILLION (WELL LSS-MW17). THE HIGHEST TCE CONCENTRATIONS DETECTED WERE 9.5 PARTS PER MILLION (WELL LSS-MW17).

THE CONCENTRATIONS OF GROUNDWATER CONTAMINANTS DECREASE SIGNIFICANTLY, AND THE WIDTH OF THE GROUNDWATER PLUME INCREASES, TOWARD THE NORTHERN PORTION OF OU1. CONCENTRATIONS OF CONTAMINANTS IN THE GROUNDWATER DECREASE BY AN ORDER OF MAGNITUDE IMMEDIATELY NORTH OF SAND CREEK. THIS IS MOST LIKELY A RESULT OF DILUTION DUE TO GROUNDWATER RECHARGE FROM THE CREEK. FIGURES 12 AND 13 DEPICT THE AREAL EXTENT OF GROUNDWATER CONTAMINATION DUE TO PCE AND TCE, RESPECTIVELY. THE AREAL DISTRIBUTION OF THESE TWO CHEMICALS IS REPRESENTATIVE OF THE DISTRIBUTION OF ALL CSC OU1 GROUNDWATER COCS WITH RESPECT TO AREAL EXTENT OF CONTAMINATION AND PHYSICAL AND CHEMICAL BEHAVIOR.

IN THE LIQUID PHASE, ALL OF THE COCS, WITH THE EXCEPTION OF VINYL CHLORIDE, ARE HEAVIER THAN WATER AND TEND TO SINK IN AN AQUIFER. CONTAMINANTS WHICH ARE HEAVIER THAN WATER ARE CALLED DENSE NON AQUEOUS-PHASE LIQUIDS (DNAPLS). DNAPLS HAVE GREATER MOBILITY AS A SEPARATE PHASE THAN LIGHTER-THAN-WATER NON AQUEOUS-PHASE LIQUIDS (REFERRED TO AS LNAPLS) DUE TO THEIR RELATIVELY LOW SOLUBILITY, HIGH DENSITY AND LOW VISCOSITY. BECAUSE OF THEIR LOW SOLUBILITY, DNAPLS DO NOT READILY MIX WITH WATER. IF A SMALL VOLUME IS SPILLED, IT FLOWS DOWNWARD UNDER GRAVITY UNTIL REACHING A RESIDUAL SATURATION IN THE VADOSE ZONE. IT CAN PARTITION INTO THE VAPOR PHASE, WITH DENSE VAPORS SINKING TO THE CAPILLARY FRINGE. INFILTRATING WATERS CAN DISSOLVE RESIDUAL CONSTITUENTS, INCLUDING VAPORS, AND CARRY THEM TO THE GROUNDWATER.

IF A LARGE VOLUME OF A DNAPL IS SPILLED, THE LIQUID MAY PENETRATE INTO THE AQUIFER AS A SEPARATE PHASE LIQUID AND POOL ABOVE AN IMPERMEABLE BARRIER. IN THE AQUIFER, THE LIQUID WILL REMAIN UNTIL DISSOLVED BY THE GROUNDWATER. GROUNDWATER CONTAMINANT CONCENTRATIONS IN EXCESS OF 10 PERCENT OF THE CHEMICAL'S SOLUBILITY LIMIT MAY INDICATE THE PRESENCE OF A PURE DNAPL SOURCE IN THE AQUIFER. PCE HAS BEEN DETECTED AT LEVELS APPROACHING 20 PERCENT OF ITS SOLUBILITY LIMIT IN THE SUSPECTED SOURCE AREAS OF OU1, INDICATING A PURE PCE RESIDUAL MAY EXIST AS A LONG-TERM SOURCE OF CONTAMINATION. HOWEVER, THE RI DID NOT LOCATE SUCH A SOURCE.

ONCE DISSOLVED, THE COCS ARE TRANSPORTED IN THE DIRECTION OF THE GROUNDWATER FLOW, AND TRAVEL AT A RATE SOMEWHAT LOWER THAN THE RATE OF GROUNDWATER MOVEMENT. ALL OF THE COCS ARE RELATIVELY MOBILE IN GROUNDWATER. THE ESTIMATED RATE OF GROUNDWATER MIGRATION IS ABOUT ONE FOOT PER DAY (SOUTH OF EAST 48TH AVENUE) AND ABOUT 10 FEET PER DAY (NORTH OF EAST 48TH AVENUE).

THE COCS (EXCEPT VINYL CHLORIDE) FOR OU1 CAN BE DEGRADED BY AEROBIC AND ANAEROBIC BACTERIA. THE COMPOUNDS ARE DEGRADED THROUGH DEHALOGENATION. ANAEROBIC BIODEGRADATION OF THE COCS MAY GENERATE VINYL CHLORIDE, WHICH IS MORE TOXIC THAN ITS PRECURSORS. VINYL CHLORIDE WAS DETECTED IN GROUNDWATER FROM 8 MONITORING WELLS. THE HIGHEST VINYL CHLORIDE CONCENTRATION WAS OBSERVED AT 30 PARTS PER BILLION. THREE OF THE VINYL CHLORIDE DETECTIONS WERE OBSERVED NORTH OF EAST 48TH AVENUE (WELLS FIT-SC4, FIT-WP4, AND LSS-MW21A). THESE DETECTIONS ARE MOST LIKELY THE RESULT OF THE BIODEGRADATION OF COCS. SUBSEQUENT BIODEGRADATION OF THE VINYL CHLORIDE IS NOT A SIGNIFICANT PROCESS UNDER NORMAL ENVIRONMENTAL CONDITIONS.

#SSR
VI. SUMMARY OF SITE RISKS

ACTUAL OR THREATENED RELEASES OF HAZARDOUS SUBSTANCES FROM THIS OU, IF NOT ADDRESSED BY IMPLEMENTING THE RESPONSE ACTION SELECTED IN THIS ROD, MAY PRESENT AN IMMINENT AND SUBSTANTIAL ENDANGERMENT TO PUBLIC HEALTH, WELFARE, OR THE ENVIRONMENT.

CERCLA MANDATES THAT EPA SELECT REMEDIES THAT PROTECT HUMAN HEALTH AND THE ENVIRONMENT FROM CURRENT AND POTENTIAL EXPOSURES TO HAZARDOUS SUBSTANCES. THEREFORE, EPA HAS CONDUCTED A BASELINE RA TO EVALUATE THE RISK POSED BY THE PRESENCE OF CONTAMINANTS AT CSC OU1. THE RISK ANALYSIS RESULTING FROM EPA'S BASELINE RA WAS USED FOR THE CSC FS AND FOR THIS ROD. THIS RISK ASSESSMENT WAS CARRIED OUT TO CHARACTERIZE THE CURRENT AND POTENTIAL THREATS TO HUMAN HEALTH AND ENVIRONMENT WHICH EXIST AT THIS OU IN THE ABSENCE OF ANY REMEDIAL ACTION.

FOR A RISK TO EXIST, THREE COMPONENTS MUST BE PRESENT: (1) A SOURCE OF CONTAMINATION; (2) A PATHWAY FOR CONTAMINANTS TO REACH HUMANS, PLANTS OR ANIMALS; AND (3) A POPULATION THAT COULD POTENTIALLY BE EXPOSED. IF ANY OF THE THREE COMPONENTS IS MISSING, NO RISK CAN EXIST.

THE KEY COMPONENT OF ANY HEALTH RISK ASSESSMENT IS THE AMOUNT OF CHEMICAL REACHING THE POPULATION. THIS IS KNOW AS THE DOSE. FOR ANY GIVEN DOSE, THERE ARE TWO GENERAL TYPES OF TOXIC RESPONSES: NON-CARCINOGENIC AND CARCINOGENIC (CANCER-CAUSING).

NON-CARCINOGENIC RISKS ARE CALCULATED BY ASSUMING THAT THERE IS A DOSE BELOW WHICH NO ADVERSE HEALTH EFFECTS WILL OCCUR. THESE CALCULATIONS ARE USUALLY BASED ON RESULTS OF ANIMAL STUDIES AND INCLUDE A NUMBER OF ADDITIONAL CONSERVATIVE ASSUMPTIONS TO TAKE INTO ACCOUNT WHAT THE ESTIMATED RISK IS TO HUMANS. FOR SUCH CHEMICALS, EXPOSURES LESS THAN THIS DOSE (REFERRED TO AS THE "REFERENCE DOSE" (RFD)) WILL RESULT IN NO TOXIC EFFECTS. POTENTIAL CONCERN FOR NON-CARCINOGENIC EFFECTS OF A SINGLE CONTAMINANT IN A SINGLE MEDIUM IS EXPRESSED AS THE HAZARD QUOTIENT (HQ) OR THE RATIO OF THE ESTIMATED INTAKE DERIVED FROM THE CONTAMINANT CONCENTRATION IN A GIVEN MEDIA REFERRED TO AS THE CHRONIC DAILY INTAKE (CDI) TO THE REFERENCE DOSE (RFD). BY ADDING THE HQS FOR ALL CONTAMINANTS WITHIN A MEDIUM OR ACROSS ALL MEDIA TO WHICH A GIVEN POPULATION MAY BE REASONABLY BE EXPOSED, THE HAZARD INDEX CAN BE GENERATED. THE HI PROVIDES A USEFUL REFERENCE POINT FOR GAUGING THE POTENTIAL SIGNIFICANCE OF MULTIPLE CONTAMINANT EXPOSURES WITHIN A SINGLE MEDIUM OR ACROSS MEDIA.

FOR CARCINOGENS, IT APPEARS THAT THERE IS NO SAFE DOSE. INSTEAD, THE RISK OF CANCER BECOMES SMALLER AND SMALLER AS THE DOSE DECREASES. CANCER POTENCY FACTORS (CPFS) ARE USED FOR ESTIMATING EXCESS LIFETIME CANCER RISKS ASSOCIATED WITH EXPOSURE TO POTENTIALLY CARCINOGENIC CHEMICALS. EXCESS LIFETIME CANCER RISKS ARE DETERMINED BY MULTIPLYING THE INTAKE LEVEL WITH THE CANCER POTENCY FACTOR. THESE RISKS ARE PROBABILITIES THAT ARE GENERALLY EXPRESSED IN SCIENTIFIC NOTATION (I.E., 1 X (10-6) OR 1E-6). AN EXCESS LIFETIME CANCER RISK OF 1 X (10-6) INDICATES THAT AN INDIVIDUAL HAS A ONE IN ONE MILLION CHANCE OF DEVELOPING CANCER AS A RESULT OF SITE-RELATED EXPOSURE TO A CARCINOGEN OVER A 70-YEAR LIFETIME UNDER THE SPECIFIC EXPOSURE CONDITIONS AT THE SITE. A RISK IN THE RANGE OF (10-4) TO (10-6) IS CONSIDERED TO BE ACCEPTABLE. EPA GENERALLY USES (10-6) AS A GOAL IN EVALUATING CLEANUP ALTERNATIVES. HOWEVER, OTHER FACTORS, SUCH AS EXPOSURE, AVAILABILITY OF CHEMICAL-SPECIFICS ARARS, TECHNICAL LIMITATIONS, BACKGROUND CONCENTRATIONS, AND UNCERTAINTIES MAY RESULT IN THE SETTING OF A DIFFERENT GOAL.

CONTAMINANTS AND TOXICITY ASSESSMENT

CSC RI RESULTS INDICATE CONTAMINATION IN THE SOIL, GROUNDWATER, AND AIR MEDIA. IN ORDER TO CHARACTERIZE SITE RISK AT CSC OU1, THE RA IDENTIFIED

NINE COCS FOR THE GROUNDWATER AND SOIL MEDIA AT THE CSC OU1. THESE CHEMICALS WERE IDENTIFIED BASED ON THE CONCENTRATIONS AT THE SITE, FREQUENCY OF DETECTION, TOXICITY, PHYSICAL/CHEMICAL PROPERTIES THAT AFFECT MOBILITY, AND PREVALENCE/PERSISTENCE IN THESE MEDIA. A LISTING OF THESE CHEMICALS IS PRESENTED IN SECTION V. THEY WERE DETERMINED TO REPRESENT THE TOTAL POTENTIAL HEALTH AND ENVIRONMENTAL RISKS AT THE SITE.

THE COCS FOR OU1 ARE A DIVERSE GROUP OF VOLATILE CHLORINATED HYDROCARBON SOLVENTS. MOST OF THE CHEMICALS ARE CENTRAL NERVOUS SYSTEM DEPRESSANTS AND EITHER LIVER OR KIDNEY TOXINS AT HIGH DOSES. SIX OF THE COCS ARE CARCINOGENIC (PCE, TCE, METHYLENE CHLORIDE, CARBON TETRACHLORIDE, 1,1-DCA, AND 1,2 DCE). THE CARCINOGENIC POTENCY OF A COMPOUND IS REPRESENTED BY ITS CANCER POTENCY FACTOR (CPF). THE CPFS FOR OU1 COCS ARE PRESENTED IN APPENDIX A. DCE AND PCE ARE GENERALLY THE CARCINOGENS PRESENT AT THE HIGHEST CONCENTRATIONS IN THE GROUNDWATER, SOIL AND SOIL GAS. THE POTENTIAL FOR THE COCS IDENTIFIED FOR OU1 TO CAUSE NONCARCINOGENIC HEALTH EFFECTS VARIES WIDELY. THE RFDS FOR THE COCS ARE PRESENTED IN TABLES 1-11, 1-12, 1-13 AND 1-14 OF APPENDIX A.

LAND USE

LAND USE WITHIN OU1 WAS ASSESSED BASED ON A SURVEY CONDUCTED BY THE TRI-COUNTY HEALTH DEPARTMENT OF COLORADO. THE LAND USE WITHIN OU1 IS LARGELY INDUSTRIAL. THE OU1 POPULATION IS COMPRISED MOSTLY OF WORKERS WHO COMMUTE FROM OUTSIDE OU1 TO JOBS IN THE OFFICE AND WAREHOUSE BUILDINGS WITHIN THE SITE. SIX RESIDENCES ARE LOCATED IN THE NORTHERN PORTION OF OU1. ONE RESIDENCE IS LOCATED ON EAST 50TH AVENUE AND THE OTHERS ARE LOCATED ON EAST 52ND AVENUE. ALL OF THE RESIDENCES WITHIN OU1 ARE CONNECTED TO THE SACWSD SYSTEM. THE ALLUVIAL GROUNDWATER WITHIN OU1, HOWEVER, IS CONSIDERED TO BE A POTENTIAL FUTURE DRINKING WATER SOURCE FOR OU1 RESIDENCES. IN ADDITION, CONTAMINATED GROUNDWATER WITHIN THE CSC OU1 AREA FLOWS NORTHWARD INTO THE CSC OU2 AREA. ALLUVIAL GROUNDWATER WITHIN THE OU2 AREA IS THE PRINCIPAL SOURCE OF WATER FOR DOMESTIC USES IN COMMERCE CITY.

BASED ON AN ANALYSIS OF CURRENT AND FUTURE LAND USE, RISK CALCULATIONS HAVE BEEN PERFORMED FOR THREE DIFFERENT POPULATIONS THAT COULD BE EXPOSED TO CONTAMINANTS PRESENT AT THE OU1 AREA: INDUSTRIAL WORKERS, CURRENT RESIDENTS AND HYPOTHETICAL FUTURE ON-SITE RESIDENTS. BASED ON THE CURRENT LAND USE, INDUSTRIAL LAND USE (I.E., OCCUPATIONAL EXPOSURE) EXISTS FOR THE AREA SOUTH OF EAST 48TH AVENUE. THIS AREA IS CURRENTLY ZONED FOR INDUSTRIAL AND COMMERCIAL USES. RESIDENTIAL LAND USE EXISTS IN THE AREA NORTH OF EAST 48TH AVENUE. IN ORDER TO ASSESS FUTURE RESIDENTIAL EXPOSURE AT THE SITE, POTENTIAL RISK ASSOCIATED WITH RESIDENTIAL LAND USE IN THE AREA SOUTH OF EAST 48TH AVENUE WAS EVALUATED. BECAUSE THIS AREA IS CURRENTLY ZONED FOR INDUSTRIAL AND COMMERCIAL USES, IT IS UNLIKELY THAT RESIDENTIAL LAND USE WILL EXIST IN THIS AREA WITHIN THE NEXT FEW YEARS. THERE IS A POSSIBILITY, HOWEVER, THAT FUTURE RESIDENTIAL DEVELOPMENT MAY OCCUR WITHIN THE CURRENT INDUSTRIAL AREA DURING THE TIME PERIOD REQUIRED TO IMPLEMENT THE REMEDIAL ALTERNATIVES EVALUATED IN THIS ROD.

THERE ARE NO ENDANGERED SPECIES AT THE CSC OU1 AREA. POTENTIAL ENVIRONMENTAL RECEPTORS INCLUDE AQUATIC HABITAT, WILDLIFE AND VEGETATION WITHIN THE SAND CREEK FLOODPLAIN. THE ALLUVIAL AQUIFER IS A CLASS I AQUIFER AS DESCRIBED IN EPA'S GROUNDWATER PROTECTION STRATEGY.

EXPOSURE ASSESSMENT

THE RESULTS OF SITE INVESTIGATIONS CONDUCTED UNDER THE CSC RI INDICATED THE PRESENCE OF CONTAMINANTS IN THE SOIL, GROUNDWATER, AND AIR MEDIA. BASED ON THESE RESULTS AND THE EVALUATION OF LAND USE AT THE SITE, THE FOLLOWING POTENTIAL EXPOSURE PATHWAYS WERE QUANTITATIVELY EVALUATED:

1. INGESTION OF GROUNDWATER CONTAMINANTS IN DRINKING WATER AND INHALATION OF VOLATILIZED CONTAMINANTS THROUGH SHOWERING (INDUSTRIAL, EXISTING AND FUTURE RESIDENTIAL LAND USES).

2. DERMAL CONTACT WITH COCS DURING SHOWERING (INDUSTRIAL, EXISTING AND FUTURE RESIDENTIAL LAND USES).

IN ADDITION, THE FOLLOWING EXISTING EXPOSURE PATHWAYS WERE QUANTITATIVELY EVALUATED:

1. DIRECT CONTACT AND INCIDENTAL INGESTION OF CONTAMINATED SOIL (INDUSTRIAL AND FUTURE RESIDENTIAL LAND USES).

2. INHALATION OF ONSITE AMBIENT AIR (INDUSTRIAL). FOR FUTURE RESIDENTS, A POTENTIAL PATHWAY EXISTS REGARDING INHALATION OF VAPORS FROM SOIL AND GROUNDWATER CONTAMINANTS IN BASEMENTS. DUE TO THE HIGH DEGREE OF UNCERTAINTY ASSOCIATED WITH QUANTITATIVELY ASSESSING RISK FROM THIS PATHWAY THROUGH USE OF THE GARBESI AND SEXTRO MODEL (1989), RISKS FOR THIS PATHWAY ARE PRESENTED QUALITATIVELY. BASEMENT VOC EXPOSURE IS NOT EVALUATED FOR THIS REASON SINCE A VALIDATED BASEMENT EXPOSURE MODEL WAS NOT AVAILABLE AT THE TIME THE RISK ASSESSMENT WAS PREPARED. SUCH POTENTIAL RISKS WILL BE REEVALUATED DURING THE 5 YEAR REVIEW TO ENSURE THE REMEDIES SELECTED ARE PROTECTIVE.

SINCE ONLY UNDETECTABLE AMOUNTS OF GROUNDWATER CONTAMINANTS DISCHARGE INTO SAND CREEK, IT WAS DETERMINED THAT A COMPLETE PATHWAY DOES NOT EXIST FOR THE ENVIRONMENTAL RECEPTORS WITHIN OU1.

CONCENTRATIONS OF CONTAMINANTS USED TO ESTIMATE CURRENT AND POTENTIAL RISK WERE BASED ON THE 95 PERCENTILE CONFIDENCE LIMIT OF THE GEOMETRIC MEAN OF DATA COLLECTED FOR THE GROUNDWATER, SOIL AND AIR MEDIA. THESE CONCENTRATIONS ARE PRESENTED IN APPENDIX A. EXPOSURE ASSUMPTIONS USED TO DETERMINE THE AVERAGE AMOUNT OF CHEMICAL IN CONTACT WITH A PARTICULAR INDIVIDUAL ARE ALSO PRESENTED IN APPENDIX A. THESE ESTIMATES REPRESENT REASONABLE MAXIMUM EXPOSURE SCENARIOS.

THE HIGHEST EXPOSURE POTENTIAL IS ASSOCIATED WITH CURRENT WORKERS AND FUTURE RESIDENTS. THIS REPRESENTS POTENTIAL EXPOSURE BASED ON CURRENT AND FUTURE USE OF THE AREA SOUTH OF EAST 48TH AVENUE. THIS RISK POTENTIAL REPRESENTS BOTH EXISTING AND POTENTIAL PATHWAYS. IN THE CASE OF CURRENT WORKERS, THERE IS NO INDICATION THAT GROUNDWATER IS USED FOR ANY DOMESTIC OR COMMERCIAL PURPOSE IN THE AREA. THE FUTURE RESIDENT SCENARIO WOULD REQUIRE CONVERSION OF THE CURRENT INDUSTRIAL AREA (SOUTH OF EAST 48TH AVENUE) TO RESIDENTIAL USE.

RISK CHARACTERIZATION

THE BASELINE RISK ASSESSMENT QUANTITATIVELY ESTIMATED POTENTIAL NONCARCINOGENIC AND CARCINOGENIC RISKS POSED BY THE COCS IN VARIOUS MEDIA AT CSC OU1. AS STATED PREVIOUSLY, NONCARCINOGENIC RISK IS PRESENTED AS THE FRACTION OF THE DAILY DOSE OF A GIVEN CHEMICAL WHICH IS ESTIMATED TO RESULT IN NO ADVERSE HEALTH EFFECTS. CARCINOGENIC RISK IS PRESENTED AS A PROBABILITY VALUE (I.E., THE CHANCE OF DEVELOPING CANCER OVER A LIFETIME). THESE RISK ESTIMATES ARE CONSERVATIVE AND MANY OVERESTIMATE THE ACTUAL RISK DUE TO EXPOSURE. A SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC RISK AT CSC OU1 IS PRESENTED IN TABLES 3 AND 4. A DESCRIPTION OF THESE RISK IS PRESENTED BELOW.

INDUSTRIAL LAND USE, NONCARCINOGENIC RISK

HIGH CONCENTRATIONS OF CONTAMINANTS IN GROUNDWATER POSE A LARGE NONCARCINOGENIC AGGREGATE RISK OF 75 DUE TO INGESTION (HI OF 62) AND INHALATION (HI OF 13) OF CONTAMINANTS DURING DRINKING AND SHOWERING WITH

CONTAMINATED GROUNDWATER. SOIL CONTAMINATION DOES NOT POSE A SIGNIFICANT NONCARCINOGENIC RISK.

INDUSTRIAL LAND USE, CARCINOGENIC RISK

HIGH CONCENTRATIONS OF CONTAMINANTS IN GROUNDWATER PRESENT A HIGH POTENTIAL CANCER RISK 5.4 X (10-2)) DUE PRIMARILY TO INGESTION AND INHALATION OF CONTAMINANTS DURING DRINKING AND SHOWERING WITH CONTAMINATED GROUNDWATER. IN ADDITION, INHALATION OF COCS IN OUTDOOR AMBIENT AIR AND DERMAL ABSORPTION OF CONTAMINANTS THROUGH DIRECT CONTACT WITH SOIL CONTAMINATION EXCEEDS EPA'S (10-6) ACCEPTABLE RISK POINT OF DEPARTURE. THE RISK POSED THROUGH INHALATION OF AMBIENT AIR IS ESTIMATED AT 5 X (10-5). THE RISK POSED THROUGH DERMAL CONTACT OF CONTAMINATED SOILS IS 2 X (10-6). THE TOTAL CANCER RISK POSED TO THIS POPULATION (WORKERS) IS 6 X (10-2). THE CHEMICALS CONTRIBUTING THE LARGEST POTENTIAL RISK ARE DCE AND PCE.

EXISTING RESIDENTIAL LAND USE, NONCARCINOGENIC RISK

CONCENTRATIONS OF CONTAMINANTS IN THE GROUNDWATER DECREASE SIGNIFICANTLY NORTH OF EAST 48TH AVENUE. DUE TO THIS FACTOR, A HAZARD INDEX OF LESS THAN 1.0 WAS DETERMINED FOR THE GROUNDWATER PATHWAY. SOIL CONTAMINATION HAS NOT BEEN DETECTED IN THE EXISTING RESIDENTIAL AREA.

EXISTING RESIDENTIAL LAND USE, CARCINOGENIC RISK

POTENTIAL CARCINOGENIC RISK POSED TO CURRENT SITE RESIDENTS IS BASED SOLELY ON THE GROUNDWATER MEDIA. DUE TO THE DECREASE IN CONCENTRATION OF GROUNDWATER CONTAMINATION IN THE EXISTING RESIDENTIAL AREA (NORTH OF EAST 48TH AVENUE), POTENTIAL CARCINOGENIC RISK POSED THROUGH INGESTION AND INHALATION OF CONTAMINANTS DURING DRINKING AND SHOWERING WITH CONTAMINATED GROUNDWATER IS MUCH LESS THAN EITHER THE WORKER OR FUTURE RESIDENT EXPOSURE SCENARIOS. THIS RISK IS ESTIMATED AT 7 X (10-4). THIS POTENTIAL RISK, HOWEVER, STILL EXCEEDS EPA'S ACCEPTABLE RISK RANGE OF (10-4) TO (10-6).

FUTURE RESIDENTIAL LAND USE, NONCARCINOGENIC RISK

POTENTIAL NONCARCINOGENIC RISKS POSED TO FUTURE SITE RESIDENTS ARE ASSOCIATED WITH THE GROUNDWATER AND SOIL MEDIA. NONCARCINOGENIC RISK AT THE SITE ARE THE HIGHEST FOR THIS POPULATION BECAUSE THIS SCENARIO ASSUMES RESIDENTIAL HABITATION IN THE MOST HIGHLY CONTAMINATED AREAS. CDI ESTIMATES ARE HIGHER FOR RESIDENTS THAN WORKERS DUE TO A HIGHER FREQUENCY AND DURATION OF EXPOSURE. THE ESTIMATED POTENTIAL NONCARCINOGENIC AGGREGATE RISK ASSOCIATED WITH THE GROUNDWATER MEDIA IS 110.

FUTURE RESIDENTIAL LAND USE, CARCINOGENIC RISK

POTENTIAL CARCINOGENIC RISKS POSED TO FUTURE SITE RESIDENTS ARE ASSOCIATED WITH CONTAMINATION DETECTED IN THE GROUNDWATER AND SOIL MEDIA. CHILDREN WERE IDENTIFIED AS THE MOST SENSITIVE GROUP OF THIS POPULATION. POTENTIAL CARCINOGENIC RISKS ASSOCIATED WITH THE GROUNDWATER MEDIA IS 1 X (10-1). POTENTIAL CARCINOGENIC RISK FOR CHILDREN THROUGH EXPOSURE TO CONTAMINATED SURFICIAL SOILS IS 2 X (10-4) DUE TO DIRECT CONTACT, INCIDENTAL INGESTION AND INHALATION. INHALATION OF CONTAMINANTS IN BASEMENTS CONSTRUCTED IN AREAS OF HIGH CONCENTRATION OF SOIL AND GROUNDWATER CONTAMINANTS WOULD MOST LIKELY PRESENT UNACCEPTABLE CARCINOGENIC AND NONCARCINOGENIC RISK.

RESULTS

THE RESULTS OF THE CSC OU1 RA INDICATE THAT CONTAMINANTS DETECTED WITHIN THIS OU POSE AN UNACCEPTABLE POTENTIAL RISK TO SITE WORKERS AND CURRENT

AND FUTURE SITE RESIDENTS. RISKS POSED TO THESE POPULATIONS EXCEED THE (10-4) RISK LEVEL. THESE RISKS REPRESENT HYPOTHETICAL EXPOSURE SINCE GROUNDWATER IS NOT CURRENTLY USED FOR DOMESTIC INDOOR USES AND NO BASEMENTS EXIST WITHIN OU1.

BASED ON THE RESULTS OF THE RA, TWO ACTUAL OR EXISTING PATHWAYS POSE UNACCEPTABLE RISKS TO PUBLIC HEALTH AT CSC OU1. THESE PATHWAYS RELATE TO SOIL CONTAMINATION AT THE SITE. CARCINOGENIC RISK POSED THROUGH INHALATION OF VOLATILE COCS IN THE AMBIENT AIR BY SITE WORKERS IS ESTIMATED AT 5 X (10-5) RISK, AND POSED THROUGH DERMAL CONTACT WITH SURFICIAL SOILS IS ESTIMATED AT 2 X (10-6) RISK. THESE RISKS EXCEED EPA'S (10-6) POINT OF DEPARTURE.

GROUNDWATER REMEDIATION LEVELS

FEDERAL REGULATIONS REQUIRE THAT MAXIMUM CONTAMINANT LEVEL GOALS (MCLGS) ESTABLISHED UNDER THE SAFE DRINKING WATER ACT, AND THAT ARE SET AT LEVELS ABOVE ZERO, SHALL BE ATTAINED BY REMEDIAL ACTIONS FOR GROUND OR SURFACE WATERS THAT ARE CURRENT OR POTENTIAL SOURCES OF DRINKING WATER, WHERE THE MCLGS ARE RELEVANT AND APPROPRIATE UNDER THE CIRCUMSTANCES OF THE RELEASE BASED ON THE FACTORS IN 40 CFR S 300.400(G)(2). IF AN MCLG IS DETERMINED NOT TO BE RELEVANT AND APPROPRIATE, THE CORRESPONDING MAXIMUM CONTAMINANT LEVEL (MCL) SHALL BE ATTAINED WHERE RELEVANT AND APPROPRIATE TO THE CIRCUMSTANCES OF THE RELEASE.

WHERE THE MCLG FOR A CONTAMINANT HAS BEEN SET AT A LEVEL OF ZERO, THE MCL PROMULGATED FOR THAT CONTAMINANT UNDER THE SAFE DRINKING WATER ACT SHALL BE ATTAINED BY REMEDIAL ACTIONS FOR GROUND OR SURFACE WATERS THAT ARE CURRENT OR POTENTIAL SOURCES OF DRINKING WATER, WHERE THE MCL IS RELEVANT AND APPROPRIATE UNDER THE CIRCUMSTANCES OF THE RELEASE BASED ON THE FACTORS IN 40 CFR S 300.400(G)(2).

IN CASES INVOLVING MULTIPLE CONTAMINANTS OR PATHWAYS WHERE ATTAINMENT OF CHEMICAL-SPECIFIC ARARS WILL RESULT IN CUMULATIVE RISK IN EXCESS OF (10-4), OTHER CRITERIA IN PARAGRAPH (E)(2)(I)(A) OF 40 CFR PART 300 MAY ALSO BE CONSIDERED WHEN DETERMINING THE CLEANUP LEVEL TO BE ATTAINED.

MAXIMUM CONTAMINANT LEVEL GOALS (MCLGS) EXIST FOR SOME OF THE CSC OU1 COCS. ALL OF THESE MCLGS ARE SET AT ZERO AND THEREFORE ARE NOT CONSIDERED IN ESTABLISHING GROUNDWATER REMEDIATION LEVELS. MCLS FOR CSC OU1 ARE AVAILABLE FOR TCE, 1,1-DCE, CIS-1,2-DCE, VINYL CHLORIDE AND CARBON TETRACHLORIDE. THE CUMULATIVE RISK ASSOCIATED WITH EXPOSURE TO GROUNDWATER CONTAMINATION AT THE MCLS FOR THESE COMPOUNDS IS 1 X (10-4) BASED ON THE INGESTION AND INHALATION OF CONTAMINANTS.

MCLS ARE DRINKING WATER STANDARDS FOR SPECIFIC CHEMICALS THAT ARE ENFORCEABLE FOR PUBLIC DRINKING WATER SYSTEMS. THESE STANDARDS ARE "RELEVANT AND APPROPRIATE" REQUIREMENTS FOR ESTABLISHING ACCEPTABLE GROUNDWATER REMEDIATION LEVELS OF CONTAMINANTS IN GROUNDWATER. PROPOSED MCLS ARE "TO BE CONSIDERED" (TBCS) FOR ESTABLISHING ACCEPTABLE GROUNDWATER REMEDIATION LEVELS IN THE GROUNDWATER FOR THOSE CHEMICALS WITHOUT A PROMULGATED FEDERAL OR STATE STANDARD. FOR THOSE CHEMICALS WITHOUT A PROMULGATED MCL, STATE STANDARD, OR PROPOSED MCL, ACCEPTABLE GROUNDWATER REMEDIATION LEVELS HAVE BEEN DERIVED BASED ON A (10-6) CANCER RISK AND PRACTICAL QUANTITATION LEVELS. PRACTICAL QUANTITATION LEVELS REPRESENT THE LOWEST CONCENTRATION THAT A LABORATORY CAN "PRACTICALLY" DETECT. RESIDENTIAL USE EXPOSURE ASSUMPTIONS WERE USED IN THE DEVELOPMENT OF THESE VALUES. ATTAINMENT OF THESE GROUNDWATER REMEDIATION LEVELS WILL ASSURE THAT RISK ASSOCIATED WITH EXPOSURE TO CONTAMINATED GROUNDWATER WILL FALL WITHIN THE ACCEPTABLE RISK RANGE OF (10-4) TO (10-6).

ACCEPTABLE GROUNDWATER REMEDIATION LEVELS AS DETERMINED BY

CHEMICAL-SPECIFIC ARARS AND TBCS FOR OU1 COCS ARE PRESENTED IN TABLE 5.

BASED ON THE EVALUATION CONDUCTED IN THE CSC OU1 BASELINE RA, EVALUATION OF CHEMICAL-SPECIFIC ARARS AND TBCS, AND EPA POLICY, THE FOLLOWING REMEDIAL ACTION OBJECTIVES HAVE BEEN ESTABLISHED FOR OU1 GROUNDWATER.

1. PREVENT INGESTION AND INHALATION OF GROUNDWATER 1) WITH CARCINOGENS IN EXCESS OF REMEDIATION LEVELS IDENTIFIED IN TABLE 5 AND, 2) WHICH PRESENTS A TOTAL CARCINOGENIC RISK RANGE GREATER THAN 1 X (10-6) - 1 X (10-4).

2. PROTECT UNCONTAMINATED GROUNDWATER FOR CURRENT AND FUTURE USE BY PREVENTING MIGRATION OF CONTAMINANTS IN EXCESS OF REMEDIATION LEVELS.

3. RESTORE CONTAMINATED GROUNDWATER TO 1) REMEDIATION LEVELS SPECIFIED TABLE 5, AND 2) CONCENTRATIONS WHICH PRESENT A TOTAL CARCINOGENIC RISK OF 1 X (10-4) - 1 X (10-6).

SOIL REMEDIATION LEVELS

APPROPRIATE SOIL REMEDIATION LEVELS WERE DETERMINED BASED UPON LEACHING OF SOIL CONTAMINANTS INTO THE UNDERLYING GROUNDWATER. LEVELS ARE BASED ON RESTORING THE GROUNDWATER TO ITS MOST BENEFICIAL USE WHICH IS DRINKING WATER (SEE TABLE 5). BASED ON EXPOSURE CALCULATIONS, PERFORMED DURING THE RA, THESE LEVELS ARE ALSO PROTECTIVE FOR THE INCIDENTAL SOIL INGESTION, INHALATION AND DIRECT CONTACT PATHWAYS.

SOIL REMEDIATION LEVELS ARE BASED ON THE GROUNDWATER REMEDIATION LEVELS, AQUIFER DILUTION, THE PHYSICAL AND CHEMICAL PROPERTIES OF THE CONTAMINANT, AND THE ABILITY OF THE SOIL TO RETARD LEACHING OF THE CONTAMINANT DUE TO ADSORPTION. SOIL REMEDIATION LEVELS WERE CALCULATED BY MULTIPLYING THE ACCEPTABLE CONCENTRATION OF LEACHATE FROM THE SOIL BY THE PARTITIONING COEFFICIENT (KD) FOR THE SOIL. THE KD REPRESENTS THE MOBILITY OF A PARTICULAR CONTAMINANT WITHIN THE SOIL AT THE CSC PROPERTY. THEY WERE DEVELOPED BASED ON SITE-SPECIFIC BATCH AND COLUMN ADSORPTION STUDIES CONDUCTED FOR CSC OU2.

THE ACCEPTABLE CONCENTRATION OF LEACHATE REPRESENTS THE AMOUNT OF CONTAMINANTS IN THE SOIL THAT WILL BE ALLOWED TO MIGRATE INTO THE GROUNDWATER. FOR CSC OU1, THIS VALUE WAS DERIVED BY MULTIPLYING THE GROUNDWATER REMEDIATION LEVELS (I.E., MCLS) BY A DILUTION/ATTENUATION FACTOR. A DILUTION/ATTENUATION FACTOR OF 100 WAS USED FOR THESE CALCULATIONS. THIS FACTOR ASSUMES THAT LEACHATE CONCENTRATIONS WILL BE REDUCED BY A FACTOR OF 100 DUE TO AQUIFER DILUTION AND SOIL ATTENUATION IN THE SOIL ABOVE THE AQUIFER. THIS VALUE HAS BEEN DETERMINED TO BE PROTECTIVE AND APPROPRIATE BASED ON EVALUATIONS AND STUDIES DOCUMENTED IN THE TOXICITY CHARACTERISTIC RULE, 40 CFR 261.

SOIL REMEDIATION LEVELS AND KD VALUES FOR THE COCS IN THE SOIL MEDIUM ARE AS FOLLOWS:

COMPOUND	GROUNDWATER REMEDIATION LEVEL	KD	X 100 =	SOIL REMEDIATION LEVEL (PPM)
PCE	0.005	0.30		0.150
TCE	0.005	0.23		0.115
1,1,1-TCA	0.200	0.22		4.400
1,1-DCE	0.070	0.15		0.105
DCA	0.005	0.18		0.090
VINYL CHLORIDE	0.002	0.06		0.012
METHYLENE CHLORIDE	0.010	0.14		0.140

SOIL REMEDIATION LEVELS ARE BASED ON SOIL DATA COLLECTED DURING THE RI/FS AND ON THE ASSUMPTION THAT THE SOIL COLUMN IS UNIFORMLY

CONTAMINATED. THESE LEVELS WILL ONLY BE REVISED IF ADDITIONAL DATA ARE COLLECTED PERTAINING TO THE MOBILITY OF CONTAMINANTS (I.E., IF COLUMN AND BATCH FLUSHING TESTS ARE CONDUCTED). THESE DATA MAY BE COLLECTED DURING REMEDIAL DESIGN/REMEDIAL ACTION (RD/RA). ANY REVISED SOIL REMEDIATION LEVELS DERIVED FROM ADDITIONAL DATA MUST BE PROTECTIVE OF GROUNDWATER BASED ON THE GROUNDWATER REMEDIATION LEVELS CITED IN TABLE 5.

#DA
VII. DESCRIPTION OF ALTERNATIVES

AN FS WAS CONDUCTED TO DEVELOP AND EVALUATE REMEDIAL ALTERNATIVES FOR OU1 AT THE CHEMICAL SALES SUPERFUND SITE. REMEDIAL ALTERNATIVES WERE ASSEMBLED FROM APPLICABLE REMEDIAL TECHNOLOGY PROCESS OPTIONS AND WERE INITIALLY EVALUATED FOR EFFECTIVENESS, IMPLEMENTABILITY, AND COST. AS A RESULT OF THIS SCREENING, THREE ALTERNATIVES WERE CONSIDERED FOR DETAILED EVALUATION. THESE THREE ALTERNATIVES (1, 3, AND 5) WERE THEN EVALUATED AND COMPARED TO THE NINE CRITERIA REQUIRED BY THE NCP. ALTERNATIVE 1, THE "NO ACTION" ALTERNATIVE, IS REQUIRED BY THE NCP TO BE RETAINED FOR DETAILED EVALUATION. THE NO ACTION ALTERNATIVE SERVES AS A BASELINE POINT OF COMPARISON FOR OTHER ALTERNATIVES.

A BATCH FLUSHING GROUNDWATER MODEL WAS USED TO ESTIMATE THE TIME REQUIRED TO CLEAN UP THE CONTAMINATED GROUNDWATER (USEPA, 1988C). THIS MODEL PREDICTS THE VOLUME OF WATER THAT WOULD BE REQUIRED TO BE REMOVED AND TREATED TO REDUCE EXISTING CONCENTRATION LEVELS TO GROUNDWATER REMEDIATION LEVELS. BECAUSE THE MODEL CANNOT SIMULATE ACTUAL CONDITIONS IN THE AQUIFER, A GREAT DEAL OF UNCERTAINTY IS ASSOCIATED WITH ESTIMATES OF AQUIFER RESTORATION TIME FRAMES.

AS STATED PREVIOUSLY, THE GROUNDWATER REMEDIATION LEVELS ARE BASED ON MCLS, PROPOSED MCLS AND (10-6) RISK. ATTAINMENT OF THESE LEVELS WILL BE PROTECTIVE OF HUMAN HEALTH AND THE ENVIRONMENT. EPA RECENTLY STUDIED THE EFFECTIVENESS OF GROUNDWATER EXTRACTION SYSTEMS IN ACHIEVING SPECIFIED GOALS AND FOUND THAT IT IS OFTEN DIFFICULT TO PREDICT THE ULTIMATE CONCENTRATION TO WHICH CONTAMINANTS IN THE GROUNDWATER MAY BE REDUCED. THE EFFECTIVENESS OF GROUNDWATER EXTRACTION MAY BE FURTHER INHIBITED IF DNAPLS ARE PRESENT. THE STUDY DID FIND THAT GROUNDWATER EXTRACTION IS AN EFFECTIVE REMEDIATION MEASURE TO PROHIBIT FURTHER MIGRATION OF CONTAMINANTS AND CAN ACHIEVE SIGNIFICANT MASS REMOVAL OF CONTAMINANTS. TWO OF THE REMEDIAL ALTERNATIVES DESCRIBED IN THIS SECTION INCLUDE GROUNDWATER EXTRACTION SYSTEMS AND ASSUME THAT IT IS TECHNICALLY FEASIBLE TO ACHIEVE THE GROUNDWATER REMEDIATION LEVELS CITED IN THIS ROD.

EXCEPT FOR THE "NO ACTION" ALTERNATIVE, WHICH INCLUDES GROUNDWATER MONITORING ONLY, EACH ALTERNATIVE INCLUDES THE FOLLOWING TWO COMMON ELEMENTS:

GROUNDWATER MONITORING

EXISTING AND FUTURE GROUNDWATER MONITORING WELLS WOULD BE SAMPLED AND ANALYZED PERIODICALLY THROUGHOUT OU1 TO ASSESS THE EFFECTIVENESS OF ONGOING REMEDIAL ACTIVITIES. MONITORING POINTS ARE ANTICIPATED TO BE LOCATED UPGRADIENT OF THE PLUME (TO DETECT CONTAMINATION FROM OTHER SOURCES), WITHIN THE PLUME (TO TRACK THE PLUME MOVEMENT DURING REMEDIATION), AND DOWNGRADIENT FROM THE OU (TO DETECT PLUME MIGRATION AND REMEDIATION EFFECTIVENESS).

NOTIFICATION OF POTENTIAL HEALTH THREAT.

UPON REQUEST FOR A WELL PERMIT WITHIN THE OU1 AREA, THE APPLICANT WOULD BE NOTIFIED BY THE COLORADO STATE ENGINEERS OFFICE OF THE POTENTIAL HEALTH RISK ASSOCIATED WITH THE CONTAMINATED GROUNDWATER UNTIL

GROUNDWATER IS CLEANED UP TO GROUNDWATER REMEDIATION LEVELS.

ALTERNATIVE 1. NO ACTION WITH GROUNDWATER MONITORING.

UNDER THIS ALTERNATIVE, EPA WOULD TAKE NO FURTHER ACTION TO CONTROL OR REMEDIATE CONTAMINATION DETECTED WITHIN OU1. GROUNDWATER MONITORING WOULD CONTINUE ON AN ANNUAL BASIS AT APPROXIMATELY 12 MONITORING WELLS. MEASURED CONTAMINANT CONCENTRATIONS WOULD BE USED TO UPDATE THE PREDICTION OF THE GROUNDWATER CONTAMINANT MIGRATION PATTERNS AND IMPACTS ON DOWNGRADIENT WATER SUPPLY WELLS. CONTAMINATED GROUNDWATER ORIGINATING FROM OU1 WOULD BE TREATED BY THE SACWSD KLEIN TREATMENT FACILITY FOR 30 YEARS, THE EXPECTED OPERATING LIFE OF THE FACILITY. RESIDENTS WITHIN THE AREA WOULD CONTINUE TO BE PROVIDED WITH WATER FROM SACWSD. BECAUSE THIS ALTERNATIVE WOULD RESULT IN CONTAMINANTS REMAINING ONSITE, CERCLA REQUIRES THAT THE SITE BE REVIEWED EVERY FIVE YEARS. IF INDICATED BY THE REVIEW, REMEDIAL ACTIONS WOULD BE IMPLEMENTED AT THAT TIME TO REMOVE OR TREAT THE WASTES.

RESULTS OF GROUNDWATER MODELING INDICATED THAT AT A MINIMUM, APPROXIMATELY 50 YEARS WOULD BE REQUIRED TO REMEDIATE THE CONTAMINATED GROUNDWATER TO GROUNDWATER REMEDIATION LEVELS BASED ON ALTERNATIVE 1. THIS ESTIMATE DOES NOT TAKE INTO CONSIDERATION THE POTENTIAL PRESENCE OF DNAPLS OR ACCOUNT FOR LEACHING OF SOIL CONTAMINANTS INTO GROUNDWATER.

THE PRESENT WORTH COST FOR ALTERATIVE 1 WOULD BE $301,000. SINCE THE ALTERNATIVE REQUIRES "NO ACTION", THERE WOULD BE NO CAPITAL COST. ANNUAL OPERATION AND MAINTENANCE (O&M) COSTS ARE ESTIMATED TO BE $19,600 FOR GROUNDWATER MONITORING.

ALTERNATIVE 3. THERMALLY ENHANCED SOIL VAPOR EXTRACTION, LOW VOLUME GROUNDWATER INTERCEPTION IN SOURCE AND PLUME AREAS, AIR STRIPPING, CATALYTIC OXIDATION IN SOURCE AREA, REINFILTRATION OF TREATED WATER.

THIS REMEDIAL ALTERNATIVE WOULD ENTAIL THE INSTALLATION OF TWO LINES OF GROUNDWATER EXTRACTION WELLS OR DRAIN SYSTEMS, ONE SOUTH OF EAST 48TH AVENUE AND ANOTHER ALONG EAST 52ND AVENUE, (FIGURE 14). ONE OR MORE AQUIFER TESTS WOULD BE REQUIRED TO OBTAIN APPROPRIATE DATA FOR DESIGN OF THESE SYSTEMS. ESTIMATES OF THE NUMBER OF WELLS AND SPECIFIC LOCATIONS OF WELLS WOULD BE REFINED DURING REMEDIAL DESIGN BASED ON AQUIFER TEST DATA, ADDITIONAL GROUNDWATER MONITORING DATA AND OTHER RELEVANT SITE AND DESIGN INFORMATION.

THE OBJECTIVE OF THE EAST 48TH AVENUE SYSTEM WOULD BE TO COLLECT CONTAMINATED GROUNDWATER FROM THE CONTAMINANT SOURCE AREA FOR TREATMENT. APPROXIMATELY 20 EXTRACTION WELLS LOCATED ALONG AN 1,800-FOOT-LONG PUMPING LINE SOUTH OF EAST 48TH AVENUE WOULD BE USED TO CONTAIN AND COLLECT THE MORE HIGHLY CONTAMINATED GROUNDWATER IN THE SOURCE AREA. THIS PUMPING LINE WOULD PRODUCE APPROXIMATELY 100 GPM. THE EXTRACTED GROUNDWATER WOULD BE TRANSPORTED TO A CENTRAL AIR STRIPPING UNIT. VOC EMISSIONS FROM THE AIR STRIPPING UNIT WOULD BE TREATED THROUGH CATALYTIC OXIDATION. THIS PROCESS WOULD RESULT IN THE DESTRUCTION OF APPROXIMATELY 97 TO 99 PERCENT OF THE VOCS EMITTED FROM THE AIR STRIPPING UNIT.

THE OBJECTIVE OF THE EAST 52ND AVENUE SYSTEM WOULD BE TO PREVENT NORTHWARD MIGRATION AND REDUCE THE IMPACT FROM THIS GROUNDWATER PLUME ON THE SACWSD WATER SUPPLY WELLS. GROUNDWATER COLLECTION WOULD BE ACCOMPLISHED USING TWO HIGH-VOLUME EXTRACTION WELLS. THESE WELLS WOULD BE LOCATED APPROXIMATELY 400 FEET SOUTH OF EAST 52ND AVENUE TO COLLECT GROUNDWATER IN THE SAND CREEK AREA AND WOULD PUMP APPROXIMATELY 420 GPM EACH. THE COMBINED FLOW OF 840 GPM WOULD BE TREATED IN A 6- TO 8-FOOT DIAMETER AIR STRIPPING TOWER. THE TOTAL VOC EMISSIONS FROM THIS TOWER

ARE ESTIMATED TO BE LESS THAN SIX POUNDS PER DAY. AIR EMISSIONS RESULTING FROM AIR STRIPPING OPERATIONS AT THE EAST 52ND AVENUE SYSTEM WOULD BE SAMPLED AS NECESSARY TO ASSURE COMPLIANCE WITH STATE OF COLORADO AIR QUALITY STANDARDS AND REGULATIONS AS PROMULGATED UNDER THE COLORADO AIR QUALITY CONTROL ACT AND EPA POLICY. THE CSC SITE IS LOCATED IN AN OZONE NON-ATTAINMENT AREA.

COLORADO AIR QUALITY REGULATIONS NOS. 1, 2, 3, 7, AND 8 ARE APPLICABLE REQUIREMENTS FOR ACTIONS INVOLVING AIR STRIPPING. THE SPECIFIC CITATIONS OF THESE REGULATIONS AND THEIR PURPOSE ARE AS FOLLOWS: (A) 5 CCR 1001-5, REG. 3, REQUIRES AIR POLLUTION EMISSION NOTICES (APENS), AIR IMPACT ANALYSES FOR TOXIC POLLUTANTS, AND THE ATTAINMENT AND MAINTENANCE OF STATE STANDARDS; (B) 5 CCR 1001-5 SEC. IVD, REG. 3, REGULATES THE ATTAINMENT AND MAINTENANCE OF ANY NATIONAL AMBIENT AIR QUALITY STANDARDS (NAAQS); (C) 5 CCR 1001-9, REG. 7, REGULATES EMISSIONS OF VOLATILE COMPOUNDS; (D) 5 CCR 1001-10, REG. 8, REGULATES VINYL CHLORIDE AND BENZENE EMISSIONS; (E) 5 CCR 1001-4, REG. 2, REQUIRES THAT THE DESIGN PROVIDE FOR ODOR-FREE OPERATIONS; AND (F) 5 CCR 1001-3, REG. 1, REQUIRES THAT PARTICULATE EMISSIONS BE MINIMIZED, OPACITY LIMITATIONS BE OBSERVED, AND A PARTICULATE EMISSION CONTROL PLAN BE FILED. FEDERAL ARARS PERTAINING TO AIR STRIPPING INCLUDE NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS FOR REGULATING VINYL CHLORIDE EMISSIONS (40 CFR 61).

IN ADDITION, EPA HAS ESTABLISHED A POLICY (OSWER DIRECTIVE 9355.0-28, CONTROL OF AIR EMISSION FROM SUPERFUND AIR STRIPPERS AT SUPERFUND GROUNDWATER SITES) REGARDING THE CONTROL OF AIR EMISSIONS FROM AIR STRIPPING UNITS AT SUPERFUND SITES LOCATED WITHIN OZONE NON-ATTAINMENT AREAS. THIS POLICY RECOMMENDS CONTROLS FOR AIR EMISSIONS EXCEEDING 3 POUNDS PER HOUR, 15 POUNDS PER DAY AND 10 TONS PER YEAR. THE ESTIMATED MAXIMUM VOC AIR EMISSIONS FROM THE EAST 52ND AVENUE SYSTEM IS LESS THAN SIX POUNDS PER DAY (BASED ON 840 GPM). IT IS ANTICIPATED THAT THIS EMISSION RATE WILL DROP SUBSTANTIALLY THROUGHOUT THE IMPLEMENTATION OF THIS ACTION. ESTIMATED RISK ASSOCIATED WITH THIS ACTION IS LESS THAN 1 X (10-6).

TREATED GROUNDWATER WOULD BE DISCHARGED TO THE AQUIFER THROUGH DOWNGRADIENT INFILTRATION TRENCHES FOR THE EAST 48TH AVENUE SYSTEM, AND DISCHARGED INTO GRAVEL-FILLED INFILTRATION BEDS LOCATED NEAR SAND CREEK FOR THE EAST 52ND AVENUE SYSTEM.

THE TREATED GROUNDWATER WOULD BE SAMPLED AS NECESSARY TO SUBSTANTIVELY COMPLY WITH UNDERGROUND INJECTION CONTROL (UIC) REQUIREMENTS (40 CFR 144, 146, AND 147), EPA RCRA REQUIREMENT SECTION 3020 AND COLORADO REGULATIONS 5 CCR 1002-2, SEC. 6.1.0; 5 CCR 1002-3 SEC. 10.1.0 AND 6 CCR 1007-3 SECTION 100.21(B). UNDER THESE REQUIREMENTS, REINJECTED GROUNDWATER MUST BE TREATED TO HEALTH-BASED LEVELS (I.E., MCLS OR PROPOSED MCLS).

CONTAMINATED SOILS CONTRIBUTING TO GROUNDWATER CONTAMINATION, WOULD BE TREATED THROUGH THE INSTALLATION AND OPERATION OF A THERMALLY ENHANCED SOIL VAPOR EXTRACTION SYSTEM. EXTRACTED VAPORS FROM BOTH THE SOIL VAPOR EXTRACTION SYSTEM AND AIR STRIPPING UNIT WOULD BE TREATED THROUGH CATALYTIC OXIDATION. THE HOT COMBUSTION GASES FROM THE CATALYTIC OXIDATION UNIT WOULD BE RECYCLED TO THE SOIL TO ENHANCE EXTRACTION OF THE SOIL CONTAMINANTS.

ON JUNE 28 - JULY 2, 1990, SOIL VAPOR EXTRACTION PILOT TESTS WERE CONDUCTED AT CSC OU1. PILOT TEST RESULTS INDICATED THAT A VAPOR EXTRACTION RATE OF 100 CUBIC FEET PER MINUTE (CFM) WOULD REMOVE CONTAMINANTS WITHIN A 75 TO 100-FOOT RADIUS. CONTAMINANT REMOVAL RATES FOR THESE TESTS RANGED FROM 7.0 TO 9.6 POUNDS PER HOUR. IN ADDITION, SIMILAR VACUUM READINGS WERE OBSERVED AT VARIOUS PRESSURE MONITORING POINTS SCREENED AT THE SAME DEPTH AND SAME DISTANCE FROM THE EXTRACTION

WELLS, INDICATING THAT SOILS WITHIN THE TEST AREA ARE RELATIVELY HOMOGENEOUS. BASED ON THE HIGH VOC REMOVAL RATES, LARGE RADIUS OF INFLUENCE AND HOMOGENEOUS NATURE OF THE SOIL, THE RESULTS OF THESE TESTS INDICATE THAT THIS TYPE OF TECHNOLOGY IS EXTREMELY EFFECTIVE IN REMOVING SOIL CONTAMINANTS AT THE CSC SITE. IT IS ANTICIPATED THAT 10 SOIL VAPOR EXTRACTION WELLS, SPACED 150 FEET APART, WITH A TOTAL EXTRACTION OF 1000 CFM (100 CFM PER WELL) WOULD BE INSTALLED UNDER THIS ALTERNATIVE. BASED ON THIS CONCEPTUAL DESIGN, IT IS ESTIMATED THAT SOIL REMEDIATION LEVELS WOULD BE ATTAINED WITHIN 150 DAYS. LABORATORY ANALYSIS OF SOIL WOULD BE CONDUCTED UPON COMPLETION OF THE SOIL VAPOR EXTRACTION ACTIVITIES TO VERIFY COMPLIANCE WITH SOIL REMEDIATION LEVELS. A FULL SUMMARY OF THE SOIL VAPOR EXTRACTION PILOT TEST IS PRESENTED IN APPENDIX J OF THE CSC OU1 RI/FS REPORT.

IT IS ESTIMATED THAT APPROXIMATELY 7 YEARS WOULD BE REQUIRED TO CLEAN UP THE GROUNDWATER PLUME AREA (BETWEEN EAST 48TH AVENUE AND SAND CREEK) AND APPROXIMATELY 34 YEARS WOULD BE REQUIRED TO ATTAIN GROUNDWATER REMEDIATION LEVELS FOR THE SOURCE AREA (SOUTH OF EAST 48TH AVENUE). CAPITAL COSTS FOR ALTERNATIVE NO. 3 WOULD BE APPROXIMATELY $733,000, WITH AN ANNUAL O & M COST OF $96,000 FOR YEARS 1-7 AND $66,000 FOR YEARS 8-34. THE PRESENT WORTH COST WOULD BE APPROXIMATELY $1,922,000.

ALTERNATIVE 5. THERMALLY ENHANCED VAPOR EXTRACTION, HIGH VOLUME GROUNDWATER EXTRACTION IN SOURCE AREA AND PLUME AREA, AIR STRIPPING, CATALYTIC OXIDATION IN SOURCE AREA, AQUIFER REINJECTION OF TREATED WATER.

THIS ALTERNATIVE IS SIMILAR TO ALTERNATIVE NO. 3, EXCEPT THAT A MORE AGGRESSIVE GROUNDWATER EXTRACTION SYSTEM WOULD BE IMPLEMENTED (FIGURE 15). SOIL CONTAMINATION WOULD BE TREATED THROUGH SOIL VAPOR EXTRACTION AS DESCRIBED IN ALTERNATIVE NO. 3. IT IS ANTICIPATED THAT 150 DAYS WOULD BE REQUIRED TO ATTAIN SOIL REMEDIATION LEVELS FOR CSC OU1.

CONTAMINATED GROUNDWATER LOCATED NEAR THE SOURCE (SOUTH OF EAST 48TH AVENUE) WOULD BE REMOVED THROUGH A PULSED PUMPING OPERATION WITH UPGRADIENT REINJECTION OF TREATED GROUNDWATER TO IMPROVE FLUSHING EFFICIENCY AND CONTAMINANT RECOVERY. A GRID OF APPROXIMATELY 65 EXTRACTION WELLS IS ESTIMATED FOR THIS ALTERNATIVE. EACH WELL WOULD BE EQUIPPED WITH A SUBMERSIBLE PUMP AND RECHARGE LINE SO THAT ANY PROBLEM WELL COULD BE USED FOR EITHER EXTRACTION OR REINFILTRATION. THE ANTICIPATED PUMPING AND RECYCLE RATE FOR THIS ALTERNATIVE IS APPROXIMATELY 250 GPM. TO MINIMIZE PUMPING VOLUMES, OPERATION OF EXTRACTION WELLS AND REINJECTION WELLS WOULD BE ALTERNATED. THE GROUNDWATER EXTRACTION SYSTEM WOULD ALSO LOWER THE WATER TABLE AND EXPOSE THE CAPILLARY FRINGE AREA AND IMPROVE VAPOR EXTRACTION FROM THIS HIGHLY CONTAMINATED REGION.

IF DNAPLS ARE PRESENT AT THE SITE, THIS ALTERNATIVE WOULD BE ABLE TO EFFECTIVELY EXTRACT AND TREAT THESE LIQUIDS DUE TO A LARGE VOLUME OF PUMPING AND NUMBER OF WELLS. IF DNAPLS ARE DETECTED, SEPARATE PUMPING OF THE DNAPLS AND THE CONTAMINATED GROUNDWATER WOULD POSSIBLY BE REQUIRED. ADDITIONALLY, IF DNAPLS ARE DETECTED, INVESTIGATIONS MAY BE REQUIRED TO DELINEATE THE POCKETS OF DNAPLS. THESE ACTIVITIES INCLUDE THE INSTALLATION OF ADDITIONAL SOIL BORINGS AND MONITORING WELLS.

SIMILARLY TO ALTERNATIVE NO. 3, AIR STRIPPING WOULD BE USED TO TREAT CONTAMINATED GROUNDWATER IN THE SOURCE AREA. GROUNDWATER WOULD BE REQUIRED TO BE TREATED TO GROUNDWATER REMEDIATION LEVELS. DUE TO THE HIGH GROUNDWATER CONTAMINANT CONCENTRATIONS IN THE SOURCE AREA, EMISSIONS FROM THE AIR STRIPPING OPERATION AT THE SOURCE AREA WOULD BE TREATED BY CATALYTIC OXIDATION. EXHAUST FROM THE CATALYTIC OXIDATION SYSTEM WOULD BE RECIRCULATED TO THE SOIL. TREATED GROUNDWATER WOULD BE SAMPLED AS NECESSARY TO COMPLY WITH FEDERAL UIC REQUIREMENTS (40 CFR

PARTS 144, 146, AND 147 AND STATE OF COLORADO REGULATIONS 5 CCR 1002-2, SEC. 6.1.0 AND 5 CCR 1002-3, SEC. 10.1.0). CONCENTRATIONS OF REINJECTED GROUNDWATER MUST BE BELOW HEALTH BASED LEVELS AS STIPULATED UNDER THESE REQUIREMENTS.

EXTRACTION OF GROUNDWATER IN THE PLUME AREA (BETWEEN EAST 48TH AVENUE AND EAST 52ND AVENUE) WOULD ALSO BE SIMILAR TO ALTERNATIVE NO. 3, WITH THE EXCEPTION OF THE ADDITION OF TWO EXTRACTION WELLS IN THE SOUTHERN PORTION OF THE PLUME AREA. THESE TWO ADDITIONAL EXTRACTION WELLS WOULD BE LOCATED IN THE MORE HEAVILY CONTAMINATED AREA BETWEEN 48TH AVENUE AND EAST 50TH AVENUE. THE EXTRACTION RATE OF THESE WELLS WOULD BE APPROXIMATELY 150 GPM. THE EXTRACTION RATE OF THE TWO EXTRACTION WELLS LOCATED BETWEEN EAST 50TH AVENUE AND EAST 52ND AVENUE WOULD BE APPROXIMATELY 350 GPM COMPARED TO 420 GPM UNDER ALTERNATIVE NO. 3. THE ESTIMATED COMBINED GROUNDWATER EXTRACTION RATE FOR THE PLUME AREA WOULD BE 1000 GPM. USE OF THE ADDITIONAL EXTRACTION WELLS WOULD MORE RAPIDLY REMOVE CONTAMINATED GROUNDWATER IN THE PLUME AREA AND WOULD REDUCE PLUME AREA REMEDIATION TIME TO APPROXIMATELY SIX YEARS.

THE ADDITIONAL WATER GENERATED BY THESE WELLS WOULD BE COMBINED WITH WATER COLLECTED AT THE TWO HIGH-VOLUME WELLS AT EAST 52ND AVENUE AND TREATED IN A CENTRAL 6- TO 8-FOOT DIAMETER AIR STRIPPING TOWER. THE TOTAL VOC EMISSIONS FROM THIS TOWER ARE ESTIMATED TO BE SIX POUNDS PER DAY. THE TREATED WATER WOULD THEN BE DISCHARGED INTO INFILTRATION BEDS OR TRENCHES OR AN EXISTING GRAVEL PIT LOCATED IN THE SAND CREEK AREA. THE TREATED GROUNDWATER WOULD BE SAMPLED AS NECESSARY TO COMPLY WITH UIC REQUIREMENTS. AIR EMISSIONS RESULTING FROM AIR STRIPPING OPERATIONS AT THE EAST 52ND AVENUE SYSTEM WOULD BE SAMPLED AS NECESSARY TO COMPLY WITH THE STATE OF COLORADO REGULATIONS PROMULGATED UNDER THE COLORADO AIR QUALITY CONTROL ACT, FEDERAL REQUIREMENTS, AND EPA POLICY. THE STATE AND FEDERAL ARARS PERTAINING TO AIR STRIPPING EMISSIONS FOR THIS ALTERNATIVE ARE IDENTICAL TO THE ARARS CITED FOR ALTERNATIVE NO. 3 (CCR 1001-5, REG. 3; 5 CCR 1001-5 SEC. IVD, REG. 3, 5 CCR 1001-9, REG. 7, 5 CCR 1001-10, REG. 8; 5 CCR 1001-4, REG. 2; 5 CCR 1001-3, REG. 1; AND 40 CFR 261). A SUMMARY OF THESE ARARS IS PROVIDED IN THE ALTERNATIVE NO. 3 DESCRIPTION AND IN APPENDIX B.

THE TREATED PLUME AREA GROUNDWATER WOULD BE SAMPLED AS NECESSARY TO COMPLY WITH FEDERAL UIC REQUIREMENTS (40 CFR 144, 146, AND 147), RCRA REQUIREMENTS (SECTION 3020) AND STATE OF COLORADO REGULATIONS (5 CCR 1002-2, SEC. 6.1.0, 5 CCR 1002-3, SEC. 10.1.0, AND 6 CCR 1007-3 SEC. 100.21(B)). AFTER TREATMENT, WATER WOULD BE DISCHARGED INTO REINFILTRATION TRENCHES OR INTO AN EXISTING GRAVEL PIT ALONG SAND CREEK.

IT IS ESTIMATED THAT APPROXIMATELY SIX YEARS WOULD BE REQUIRED TO ATTAIN EPA GROUNDWATER REMEDIATION LEVELS IN THE PLUME AREA AND APPROXIMATELY 13 YEARS WOULD BE REQUIRED TO ATTAIN EPA GROUNDWATER REMEDIATION LEVELS IN THE SOURCE AREA.

CAPITAL COST FOR ALTERATIVE NO. 5 WOULD BE APPROXIMATELY $989,000. ANNUAL O & M COST ARE ESTIMATED AT $135,000 FOR YEARS 1-6 AND $95,000 FOR YEARS 7-13. THE PRESENT WORTH COST WOULD BE APPROXIMATELY $2,081,000.

#SCAA

VIII. SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

THE REMEDIAL ALTERNATIVES DEVELOPED IN THE CSC OU1 FS WERE ANALYZED IN DETAIL USING NINE EVALUATION CRITERIA. THE RESULTING STRENGTHS AND WEAKNESSES OF THE ALTERNATIVES WERE THEN WEIGHED TO IDENTIFY ALTERNATIVES PROVIDING THE BEST BALANCE AMONG THE NINE CRITERIA. THESE CRITERIA ARE (1) OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT;

(2) COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS), (3) REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT, (4) LONG TERM EFFECTIVENESS AND PERMANENCE; (5) SHORT-TERM EFFECTIVENESS; (6) IMPLEMENTABILITY; (7) COST; (8)STATE ACCEPTANCE; AND (9) COMMUNITY ACCEPTANCE. EACH OF THESE CRITERIA IS DESCRIBED BELOW.

CRITERION 1: PROTECTION OF HUMAN HEALTH AND ENVIRONMENT

OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT ADDRESSES WHETHER A REMEDY PROVIDES ADEQUATE PROTECTION AND DESCRIBES HOW RISKS POSED THROUGH EACH PATHWAY ARE ELIMINATED, REDUCED, OR CONTROLLED THROUGH TREATMENT, ENGINEERING CONTROLS, OR INSTITUTIONAL CONTROLS.

THE "NO ACTION" ALTERNATIVE (ALTERNATIVE NO. 1) IS NOT PROTECTIVE OF THE ENVIRONMENT BECAUSE IT WOULD NOT ELIMINATE OR REDUCE RISK THROUGH THE TREATMENT OF CONTAMINANTS IN SOIL AND GROUNDWATER. DUE TO THE OBSERVED SOIL CONTAMINATION, AN UNACCEPTABLE RISK WOULD EXIST UNDER ALTERNATIVE NO. 1 THROUGH DIRECT CONTACT WITH CONTAMINATED SOIL (INDUSTRIAL EXPOSURE). CURRENT RISK ASSOCIATED WITH INHALATION OF VOLATILE CONTAMINANTS IN AMBIENT AIR (INDUSTRIAL EXPOSURE) IS OUTSIDE THE ACCEPTABLE RISK RANGE. IN ADDITION, WITH REGARD TO POTENTIAL PATHWAYS ASSOCIATED WITH GROUNDWATER USE, THIS ALTERNATIVE IS NOT PROTECTIVE OF PUBLIC HEALTH AND THE ENVIRONMENT (AGGREGATE RISKS OF 6 X (10-2) CURRENT WORKERS; 7 X (10-4) CURRENT RESIDENTS; AND 2 X (10-1) FUTURE RESIDENTS) AND DOES NOT REDUCE POTENTIAL RISKS ASSOCIATED THESE PATHWAYS.

ALTERNATIVE NOS. 3 AND 5 ARE PROTECTIVE OF PUBLIC HEALTH AND THE ENVIRONMENT. ALL THE TREATMENT TECHNOLOGIES EMPLOYED BY THESE ALTERNATIVES ARE PROTECTIVE OF HUMAN HEALTH AND THE ENVIRONMENT BY ELIMINATING OR REDUCING RISK THROUGH THE TREATMENT OF CONTAMINANTS IN SOILS AND GROUNDWATER. ALTERNATIVE NO. 5, HOWEVER, WOULD REDUCE RISKS ASSOCIATED WITH GROUNDWATER IN LESS THAN ONE THIRD OF THE TIME REQUIRED BY ALTERNATIVE NO. 3, THEREBY REDUCING THE PERIOD OF POTENTIAL EXPOSURE BY TWO THIRDS.

CRITERION 2: COMPLIANCE WITH APPLICABLE RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS).

APPLICABLE REQUIREMENTS ARE THOSE CLEANUP STANDARDS, STANDARDS OF CONTROL, AND OTHER SUBSTANTIVE REQUIREMENTS, CRITERIA, OR LIMITATIONS PROMULGATED UNDER FEDERAL OR STATE ENVIRONMENTAL OR FACILITY SITING LAW THAT SPECIFICALLY ADDRESS A HAZARDOUS SUBSTANCE, POLLUTANT, CONTAMINANT, REMEDIAL ACTION, LOCATION, OR OTHER CIRCUMSTANCE AT A CERCLA SITE. RELEVANT AND APPROPRIATE REQUIREMENTS ARE THOSE CLEANUP STANDARDS, STANDARDS OF CONTROL, AND OTHER SUBSTANTIVE REQUIREMENTS, CRITERIA, OR LIMITATIONS PROMULGATED UNDER FEDERAL OR STATE ENVIRONMENTAL SITING LAW THAT WHILE NOT "APPLICABLE" TO A HAZARDOUS SUBSTANCE, POLLUTANT, CONTAMINANT, REMEDIAL ACTION, LOCATION, OR OTHER CIRCUMSTANCE AT A CERCLA SITE, ADDRESS PROBLEMS OR SITUATIONS SUFFICIENTLY SIMILAR TO THOSE ENCOUNTERED AT THE CERCLA SITE THAT THEIR USE IS WELL SUITED TO THE PARTICULAR SITE.

COMPLIANCE WITH ARARS ADDRESSES WHETHER A REMEDY WILL MEET ALL FEDERAL AND STATE ENVIRONMENTAL LAWS AND/OR PROVIDE BASIS FOR A WAIVER FROM ANY OF THESE LAWS. THESE ARARS ARE DIVIDED INTO CHEMICAL SPECIFIC, ACTION SPECIFIC, AND LOCATION SPECIFIC GROUPS.

ALTERNATIVE NOS. 3 AND 5 WOULD COMPLY WITH ALL ARARS. ALTERNATIVE NO. 1 WOULD NOT COMPLY WITH CHEMICAL-SPECIFIC ARARS FOR ALLUVIAL GROUNDWATER. THE ALLUVIAL GROUNDWATER WOULD NOT BE CLEANED UP TO FEDERAL AND STATE STANDARDS WITHIN A REASONABLE TIME FRAME (I.E., LESS THAN 50 YEARS). BECAUSE THE NO ACTION ALTERNATIVE DOES NOT SATISFY THE REQUIREMENTS OF THE THRESHOLD CRITERIA (PROTECTION OF PUBLIC HEALTH AND ATTAINMENT OF

ARARS), IT WILL NOT BE DISCUSSED UNDER THE EVALUATION OF THE OTHER SEVEN CRITERIA. AN EVALUATION OF ARARS FOR CSC OU1 IS PROVIDED IN APPENDIX B.

CRITERION 3: LONG-TERM EFFECTIVENESS AND PERMANENCE

LONG-TERM EFFECTIVENESS AND PERMANENCE REFERS TO THE ABILITY OF A REMEDY TO MAINTAIN RELIABLE PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT OVER TIME. THIS CRITERION INCLUDES THE CONSIDERATION OF RESIDUAL RISK AND THE ADEQUACY AND RELIABILITY OF CONTROLS.

ALTERNATIVE NO. 5 WOULD RESULT IN MINIMAL RESIDUAL RISKS. UNDER THIS ALTERNATIVE, SOIL AND GROUNDWATER CONTAMINANTS WOULD BE REDUCED TO ACCEPTABLE LEVELS THROUGH TREATMENT. IT IS ANTICIPATED THAT ALTERNATIVE NO. 3 WOULD ALSO RESULT IN MINIMAL RISK UNLESS DNAPLS ARE PRESENT. IF POCKETS OF DNAPLS ARE DETECTED TO BE PRESENT, THIS ALTERNATIVE WOULD NOT BE EFFECTIVE AT REMOVING THESE LIQUIDS. THESE LIQUIDS WOULD CONTINUE TO ACT AS A SOURCE OF CONTAMINATION TO THE ALLUVIAL GROUNDWATER. DUE TO THE LONG PERIOD OF TIME REQUIRED TO IMPLEMENT ALTERNATIVE NO. 3, THIS ALTERNATIVE WOULD NOT BE EFFECTIVE IN CONTROLLING RISK DURING THE PERIOD OF IMPLEMENTATION.

CRITERION 4: REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT

REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT REFERS TO THE PREFERENCE FOR A REMEDY THAT USES TREATMENT TO REDUCE HEALTH HAZARDS, CONTAMINANT MIGRATION, OR THE QUANTITY OF CONTAMINANTS AT THE SITE. ALL THE ALTERNATIVES EMPLOY AN IRREVERSIBLE TREATMENT AS A PRIMARY ELEMENT TO ADDRESS THE PRINCIPAL THREAT OF CONTAMINATION. BOTH ALTERNATIVE NOS. 3 AND 5 REDUCE TOXICITY, MOBILITY, AND VOLUME OF CONTAMINANTS IN SOIL AND GROUNDWATER IN THE SOURCE AREA THROUGH CATALYTIC OXIDATION. WITH REGARD TO TREATMENT OF GROUNDWATER IN THE PLUME AREA, THESE ALTERNATIVES INDIRECTLY REDUCE TOXICITY AND VOLUME THROUGH PHOTODEGRADATION OF CONTAMINANTS. ALTERNATIVE NO. 3 WILL NOT MEET EPA'S STATUTORY PREFERENCE FOR TREATMENT OF A PRINCIPAL THREAT OF CONTAMINATION TO THE MAXIMUM EXTENT PRACTICABLE, IF DNAPLS ARE PRESENT.

CRITERION 5: SHORT-TERM EFFECTIVENESS

SHORT-TERM EFFECTIVENESS REFERS TO THE PERIOD OF TIME NEEDED TO COMPLETE THE REMEDY AND ANY ADVERSE IMPACTS ON HUMAN HEALTH AND THE ENVIRONMENT THAT MAY BE POSED DURING CONSTRUCTION AND IMPLEMENTATION OF THE REMEDY.

DUE TO A LARGER EXTRACTION VOLUME, GREATER NUMBER OF WELLS, AND CONSTRUCTION DESIGN, ALTERNATIVE NO. 5 WOULD ACHIEVE GROUNDWATER REMEDIATION LEVELS IN ONE THIRD THE TIME REQUIRED UNDER ALTERNATIVE NO. 3. THESE ALTERNATIVES ARE NOT EXPECTED TO POSE ANY APPRECIABLE SHORT-TERM RISKS TO THE COMMUNITY AND WORKERS DURING CONSTRUCTION AND IMPLEMENTATION.

ALTERNATIVES NOS. 3 AND 5 RELEASE EMISSIONS TO THE ATMOSPHERE, BUT AT NEGLIGIBLE LEVELS AND MINIMAL RISK (I.E., LESS THAN 1 X (10-6)). ADDITIONAL CONTROLS FOR THESE TWO ALTERNATIVES INCLUDE MONITORING TO ENSURE COMPLIANCE WITH STATE OF COLORADO AIR QUALITY STANDARDS, AND A REASONABLE AVAILABLE CONTROL TECHNOLOGY ANALYSIS TO ENSURE EMISSIONS ARE MINIMIZED.

CRITERION 6: IMPLEMENTABILITY

IMPLEMENTABILITY REFERS TO THE TECHNICAL AND ADMINISTRATIVE FEASIBILITY OF THE REMEDY, INCLUDING THE AVAILABILITY OF MATERIALS AND SERVICES NEEDED TO IMPLEMENT THE CHOSEN SOLUTION. IT ALSO INCLUDES COORDINATION OF FEDERAL, STATE AND LOCAL GOVERNMENTS TO CLEAN UP THE SITE.

BOTH ALTERNATIVE NOS. 3 AND 5 ARE TECHNICALLY AND ADMINISTRATIVELY FEASIBLE. ALTERNATIVE NO. 3 WOULD BE SLIGHTLY MORE EASY TO IMPLEMENT THAN ALTERNATIVE NO. 5 BECAUSE OF THE TECHNICAL COMPLEXITIES ASSOCIATED WITH A PULSED PUMPING SYSTEM. IN ALTERNATIVE NO. 5, CATALYST WOULD BE REQUIRED TO BE REPLACED MORE FREQUENTLY AND ACCESS WOULD BE REQUIRED TO BE OBTAINED FROM A SIGNIFICANT NUMBER OF PROPERTY OWNERS. THESE CONCERNS ARE CONSIDERED TO BE MINOR AND TECHNICALLY AND ADMINISTRATIVELY FEASIBLE.

BOTH ALTERNATIVES REQUIRE AIR AND GROUNDWATER MONITORING. AIR MONITORING ACTIVITIES WOULD BE COORDINATED WITH EPA AND THE STATE OF COLORADO.

CRITERION 7: COST

THIS CRITERION EXAMINES THE ESTIMATED COSTS FOR EACH REMEDIAL ALTERNATIVE. FOR COMPARISON, CAPITAL AND ANNUAL O & M COSTS ARE USED TO CALCULATE A PRESENT WORTH COST FOR EACH ALTERNATIVE. ALTERNATIVE NO. 3 HAS LOWER O & M AND CAPITAL COSTS THAN ALTERNATIVE NO. 5. THE PRESENT WORTH COSTS OF ALTERNATIVE NO. 3 AND ALTERNATIVE NO. 5 ARE RELATIVELY EQUIVALENT ($1,922,000 AND $2,081,000 RESPECTIVELY); HOWEVER, ALTERNATIVE NO. 5 WOULD BE COMPLETED IN A MUCH SHORTER TIME.

CRITERION 8: STATE ACCEPTANCE

THIS CRITERION PERTAINS TO THE STATE OF COLORADO'S OPPOSITION, SUPPORT, OR COMMENT REGARDING THE REMEDIAL ALTERNATIVES PROPOSED FOR CSC OU1. THE STATE OF COLORADO HAS BEEN ACTIVELY INVOLVED THROUGHOUT THE RI/FS AND REMEDY SELECTION PROCESS. THE STATE OF COLORADO WAS PROVIDED THE OPPORTUNITY TO COMMENT ON THE RI/FS DOCUMENT AND PROPOSED PLAN, AND TOOK PART IN THE PUBLIC MEETING HELD TO INFORM THE PUBLIC ON THE PROPOSED PLAN. WRITTEN COMMENTS FROM THE STATE OF COLORADO RECEIVED DURING THE PUBLIC COMMENT PERIOD INDICATE THAT THE STATE CONCURS WITH EPA'S IDENTIFICATION OF ALTERNATIVE 5 AS THE PREFERRED REMEDY FOR CSC OU1. THE STATE OF COLORADO INDICATED, HOWEVER, THAT SEVERAL STATE REQUIREMENTS WERE IGNORED IN THE FS AND NOTED CONCERNS REGARDING EXPOSURE CALCULATION CONDUCTED TO ASSESS PUBLIC HEALTH IMPACTS RESULTING FROM AIR STRIPPING. THE STATE OF COLORADO'S COMMENTS ARE FURTHER ADDRESSED IN THE ATTACHED RESPONSIVENESS SUMMARY.

CRITERION 9: COMMUNITY ACCEPTANCE

COMMUNITY ACCEPTANCE INCLUDES DETERMINING WHICH COMPONENTS OF THE ALTERNATIVES INTERESTED PERSONS IN THE COMMUNITY SUPPORT, HAVE RESERVATIONS ABOUT, OR OPPOSE. EPA SOLICITED INPUT FROM THE COMMUNITY ON THE CLEAN UP METHODS PROPOSED FOR CSC OU1. ALTHOUGH PUBLIC COMMENT INDICATED NO OPPOSITION TO THE PREFERRED ALTERNATIVE, MANY CSC SITE RESIDENTS RAISED CONCERNS AT THE PUBLIC MEETING OVER CUMULATIVE PUBLIC HEALTH IMPACTS RESULTING FROM AIR STRIPPING OPERATIONS EITHER PROPOSED OR IN OPERATION AT CSC OU1, CSC OU2, AND THE ROCKY MOUNTAIN ARSENAL.

#SR
IX. THE SELECTED REMEDY

EPA HAS SELECTED ALTERNATIVE NO. 5 AS THE REMEDY FOR THE CSC SITE OU NO. 1. THIS REMEDY IS COMPRISED OF THE FOLLOWING COMPONENTS:

* MONITORING GROUNDWATER, DISCHARGED TREATED WATER AND AIR; MONITORING WILL INCLUDE DETERMINATION OF THE PRESENCE OR ABSENCE OF DNAPLS;

* NOTIFICATION BY THE COLORADO STATE ENGINEERS OFFICE OF THE POTENTIAL HEALTH RISKS ASSOCIATED

WITH USE OF CONTAMINATED GROUNDWATER UPON REQUEST FOR AN ALLUVIAL WELL PERMIT WITHIN THE OU1 AREA;

* HIGH VOLUME (1000 GPM) AND PULSED PUMPING OF GROUNDWATER EXCEEDING GROUNDWATER REMEDIATION LEVELS (I.E., MCLS AND PROPOSED MCLS) IN THE SOURCE AREA (AREA SOUTH OF EAST 48TH AVENUE);

* HIGH VOLUME (1000 GPM) GROUNDWATER EXTRACTION WITHIN THE CSC PLUME AREA (AREA NORTH OF EAST 48TH AVENUE AND SOUTH OF SAND CREEK);

* TREATMENT OF CONTAMINATED GROUNDWATER WITH TWO AIR STRIPPING TOWERS FOR BOTH SOURCE AND PLUME AREAS; THE SOURCE AREA AIR STRIPPING TOWER WOULD BE LOCATED ON THE CSC PROPERTY. THE PLUME AREA AIR STRIPPER WOULD BE LOCATED NEAR EAST 52ND AVENUE;

* REINJECTION AND REINFILTRATION OF TREATED GROUNDWATER. AQUIFER REINJECTION BY WELLS FOR TREATED WATER FROM THE SOURCE AREA. REINFILTRATION THROUGH DISCHARGE INTO A TRENCH OR GRAVEL PIT FOR TREATED WATER FROM THE PLUME AREA;

* SOIL VAPOR EXTRACTION OF CONTAMINATED SOILS EXCEEDING SOIL REMEDIATION LEVELS;

* CATALYTIC OXIDATION OF AIR EMISSIONS FROM THE SOIL VAPOR EXTRACTION SYSTEM AND SOURCE AREA AIR STRIPPING UNIT. RECIRCULATION OF EXHAUST FROM THE CATALYTIC OXIDATION SYSTEM INTO THE CONTAMINATED SOIL.

THE REMEDIAL DESIGN WILL SPECIFY THE APPROPRIATE NUMBER AND LOCATIONS OF WELLS AND MONITORING POINTS, AND SYSTEM PARAMETERS SUCH AS FLOW RATES FOR THE SOURCE AND PLUME AREA SYSTEMS. THE PRESENCE OR ABSENCE OF DNAPLS WILL BE MONITORED DURING RA. HOW THIS MONITORING WILL BE CONDUCTED WILL BE DETERMINED DURING RD. SOME MODIFICATIONS OR REFINEMENTS MAY BE MADE TO THE REMEDY DURING REMEDIAL DESIGN AND CONSTRUCTION. SUCH MODIFICATIONS OR REFINEMENTS, IN GENERAL WOULD REFLECT RESULTS OF THE ENGINEERING DESIGN PROCESS. ESTIMATED COST FOR THE SELECTED REMEDY IS $2,081,000.

THE SELECTION OF THIS REMEDY IS BASED UPON THE COMPARATIVE ANALYSIS OF ALTERNATIVES PRESENTED IN SECTION VIII, AND PROVIDES THE BEST BALANCE OF TRADEOFFS WITH RESPECT TO THE NINE EVALUATION CRITERIA. ARARS FOR THE SELECTED REMEDY ARE PROVIDED IN APPENDIX B. SHORT TERM EFFECTIVENESS WAS CRITICAL IN SELECTING ALTERNATIVE NO. 5. THIS ALTERNATIVE WILL CLEAN UP THE GROUNDWATER IN APPROXIMATELY ONE THIRD LESS TIME AND AT RELATIVELY THE SAME COST AS ALTERNATIVE NO. 3. THE SELECTED REMEDY WILL ALSO EFFECTIVELY REMOVE AND TREAT DNAPL'S IF DETECTED DURING RD/RA.

REMEDIATION GOALS AND PERFORMANCE STANDARDS FOR GROUND WATER AND SOIL

REMEDIAL ACTION OBJECTIVES
REMEDIAL ACTION OBJECTIVES FOR THIS SITE ARE PRESENTED IN SECTION VI.

GROUND WATER

AREA OF ATTAINMENT

THE AREA OF ATTAINMENT FOR THE GROUND WATER REMEDIATION SHALL BE THE ENTIRE CSC OU1 PLUME EXCEEDING GROUND WATER REMEDIATION LEVELS FOR ALL COCS. THIS INCLUDES GROUND WATER EXCEEDING REMEDIATION LEVELS WITHIN CSC OU1, IRRESPECTIVE OF CSC AND IDCA PROPERTY BOUNDARIES. THE ESTIMATED AREA REQUIRING REMEDIATION IS SHOWN ON FIGURE 12. PCE IS AN INDICATOR COMPOUND FOR THE VOLATILE ORGANIC PLUME. THE PLUME AREA SHOWN IN FIGURE 12 CURRENTLY INCLUDES ALL AREAS WHERE OTHER COCS EXCEED THEIR RESPECTIVE REMEDIATION LEVELS. THIS AREA MAY BE REVISED BASED ON WATER QUALITY SAMPLING DURING RD/RA.

RESTORATION TIME FRAME

THE RESTORATION TIME FRAME FOR THIS REMEDIAL ACTION IS ESTIMATED TO BE APPROXIMATELY SIX YEARS IN THE SOURCE AREA (SOUTH OF EAST 48TH AVENUE) AND APPROXIMATELY 13 YEARS IN THE PLUME AREA (BETWEEN SAND CREEK AND EAST 48TH AVENUE).

PERFORMANCE STANDARDS

SPECIFIC PERFORMANCE STANDARDS, USED TO ENSURE ATTAINMENT OF THE REMEDIAL ACTION OBJECTIVES FOR GROUND WATER ARE:

1) REDUCE CONTAMINANT CONCENTRATIONS IN GROUND WATER WITHIN THE AREA OF ATTAINMENT TO THE REMEDIATION LEVELS SPECIFIED IN TABLE 5 AND TO LEVELS WHICH PRESENT A TOTAL CARCINOGENIC RISK OF (10-4) TO (10-6).

2) ENSURE CAPTURE OF THE PLUME WITHIN THE AREA OF ATTAINMENT. VERIFY

THAT PLUME MOVEMENT IS BEING CONTROLLED BY MEASURING HYDRAULIC GRADIENT WITHIN AND OUTSIDE OF THE PLUME, AND DEMONSTRATING THAT THE GRADIENT IS INWARD TOWARD THE PUMPING WELLS.

3) MEET ALL ARARS IDENTIFIED IN THIS ROD FOR THE REMEDIATION OF GROUND WATER, INCLUDING REQUIREMENTS FOR AIR EMISSIONS MONITORING AND UIC REQUIREMENTS FOR REINJECTION OF GROUND WATER.

4) THE REMEDIAL ACTION SHALL BE CONSIDERED COMPLETE AFTER THE REMEDIATION LEVELS HAVE BEEN MAINTAINED IN ALL COMPLIANCE MONITORING WELLS FOR FOUR YEARS.

THE EXTRACTION SYSTEM SHALL CONTINUE TO OPERATE UNTIL REMEDIATION LEVELS HAVE BEEN MAINTAINED IN ALL COMPLIANCE MONITORING WELLS FOR FOUR CONSECUTIVE QUARTERS OF SAMPLING.

AFTER THAT TIME, GROUND WATER EXTRACTION MAY BE TERMINATED UPON APPROVAL BY EPA. THE REMEDIATION LEVELS MUST THEN BE MET FOR THREE ADDITIONAL YEARS (WITH A SAMPLING FREQUENCY TO BE DETERMINED DURING RD/RA, BUT EXPECTED TO BE QUARTERLY), AFTER WHICH THE REMEDIAL ACTION MAY BE CONSIDERED COMPLETE. AFTER THE REMEDIAL ACTION IS COMPLETE, THERE MAY BE ADDITIONAL MONITORING REQUIRED BY EPA, AT EPA'S SOLE DISCRETION. IF ANY EXCEDENCE OF THE PERFORMANCE STANDARDS OCCURS IN ANY OF THE COMPLIANCE MONITORING WELLS DURING THIS THREE-YEAR PERIOD, THE EXTRACTION AND TREATMENT SYSTEM SHALL BE RESTARTED AND OPERATED UNTIL PERFORMANCE STANDARD ARE AGAIN ATTAINED IN ALL COMPLIANCE MONITORING WELLS. THIS CYCLE SHALL CONTINUE UNTIL QUARTERLY MONITORING FOR ONE YEAR DEMONSTRATES NO EXCEDENCE OF PERFORMANCE STANDARDS IN THE COMPLIANCE MONITORING WELLS.

THE WELLS TO BE USED FOR COMPLIANCE MONITORING FOR WATER QUALITY AND WATER LEVELS WILL BE APPROVED BY EPA DURING REVIEW OF THE 60 PERCENT RD COMPLETION REPORT, AND WILL, AT A MINIMUM, INCLUDE WELLS UPGRADIENT OF THE PLUME, WITHIN THE PLUME, AROUND THE PLUME, AND DOWNGRADIENT OF THE PLUME. ANY STATISTICAL METHODS TO AVERAGE WELL CONCENTRATIONS SHALL BE

SPECIFIED DURING RD/RA.

THE THIRD REMEDIAL ACTION OBJECTIVE, STATED ABOVE, IS TO RESTORE GROUND WATER TO ITS BENEFICIAL USE AS A DRINKING WATER AQUIFER. BASED ON INFORMATION OBTAINED DURING THE REMEDIAL INVESTIGATION AND A CAREFUL ANALYSIS OF ALL REMEDIAL ALTERNATIVES, EPA AND THE STATE OF COLORADO BELIEVE THAT THE SELECTED REMEDY WILL ACHIEVE THIS OBJECTIVE. IT MAY BECOME APPARENT, HOWEVER, DURING IMPLEMENTATION OR OPERATION OF THE GROUND WATER EXTRACTION SYSTEM AND ITS MODIFICATIONS, THAT CONTAMINANT LEVELS HAVE CEASED TO DECLINE OR ARE REMAINING CONSTANT AT LEVELS HIGHER THAN THE REMEDIATION GOAL OVER SOME PORTION OF THE CONTAMINATED PLUME. IN SUCH A CASE, THE SYSTEM'S PERFORMANCE STANDARDS AND/OR THE REMEDY MAY BE REEVALUATED. IF NEW EXTRACTION OR REMEDIATION TECHNOLOGIES BECOME AVAILABLE IN THE FUTURE WHICH WOULD SIGNIFICANTLY IMPROVE THE REMEDIATION PROCESS (ALLOW ATTAINMENT OF REMEDIATION LEVELS WHICH WERE NOT PREVIOUSLY ATTAINABLE, OR EXPEDITE THE CLEANUP), THE REMEDY WILL BE REEVALUATED IN LIGHT OF THE NEW INFORMATION.

THE SELECTED REMEDY WILL INCLUDE GROUND WATER EXTRACTION FOR AN ESTIMATED PERIOD OF SIX YEARS IN THE SOURCE AREA AND 13 YEARS IN THE PLUME AREA, DURING WHICH TIME THE SYSTEM'S PERFORMANCE WILL BE CAREFULLY MONITORED ON A REGULAR BASIS AND ADJUSTED AS WARRANTED BY THE PERFORMANCE DATA COLLECTED DURING OPERATION. MODIFICATIONS MAY INCLUDE ANY OR ALL OF THE FOLLOWING:

A) AT INDIVIDUAL WELLS WHERE CLEANUP GOALS HAVE BEEN ATTAINED, PUMPING MAY BE DISCONTINUED;

B) ALTERNATING PUMPING AT WELLS TO ELIMINATE STAGNATION POINTS;

C) PULSE PUMPING TO ALLOW AQUIFER EQUILIBRATION AND TO ALLOW ADSORBED CONTAMINANTS TO PARTITION INTO GROUND WATER; AND

D) INSTALLING ADDITIONAL EXTRACTION WELLS TO FACILITATE OR ACCELERATE CLEANUP OF THE CONTAMINANT PLUME.

TO ENSURE THAT REMEDIATION LEVELS ARE MAINTAINED AT THOSE WELLS WHERE PUMPING HAS CEASED, THOSE WELLS WILL BE MONITORED EVERY YEAR FOLLOWING DISCONTINUATION OF GROUNDWATER EXTRACTION, UNTIL THE REMEDIAL ACTION IS COMPLETED.

5) BEST EFFORTS SHALL BE USED TO REMEDIATE THE PLUME IN A TIMELY MANNER. "BEST EFFORTS" SHALL INCLUDE IMPLEMENTATION OF THE REMEDY IN COMPLIANCE WITH THE ROD, CONSENT DECREE AND SOW, TO MAXIMIZE PERFORMANCE OF THE REMEDIAL ACTION TO ACHIEVE THE PERFORMANCE STANDARDS AS QUICKLY AS POSSIBLE.

PERFORMANCE AND COMPLIANCE SAMPLING PROGRAM

A SAMPLING PROGRAM FOR MONITORING THE REMEDIAL ACTION PERFORMANCE AND FOR DETERMINING COMPLIANCE WITH THE PERFORMANCE STANDARDS SHALL BE IMPLEMENTED DURING THE REMEDIAL ACTION. THIS PROGRAM WILL BE DEVELOPED DURING REMEDIAL DESIGN AND SHALL INCLUDE, AT A MINIMUM, THE FOLLOWING: LOCATIONS OF PERFORMANCE AND COMPLIANCE MONITORING WELLS FOR WATER QUALITY SAMPLING, FREQUENCY OF MONITORING OF PERFORMANCE AND COMPLIANCE WELLS, ANALYTICAL PARAMETERS (FOCUSING ON COCS WITH POSSIBLE USE OF INDICATOR CHEMICALS), SAMPLING FIELD METHODS, WATER LEVEL MEASUREMENT FREQUENCY, ANALYTICAL METHODS FOR CHEMICAL ANALYSIS (WITH POSSIBLE USE OF NON-CLP ANALYSIS), LOCATIONS AND METHODS FOR WATER LEVEL MEASUREMENT, AND STATISTICAL METHODS FOR EVALUATING DATA. THE PERFORMANCE AND COMPLIANCE SAMPLING PROGRAM WILL BE SPECIFIED IN THE RA WORKPLAN AND MAY BE MODIFIED DURING THE RA.

THE PERFORMANCE MONITORING SYSTEM WILL BE DESIGNED TO PROVIDE INFORMATION THAT CAN BE USED TO EVALUATE THE EFFECTIVENESS OF THE REMEDIAL ACTION WITH RESPECT TO THE FOLLOWING:

* HORIZONTAL AND VERTICAL EXTENT OF THE PLUME AND CONTAMINANT CONCENTRATION GRADIENTS, INCLUDING A MASS BALANCE CALCULATION, IF POSSIBLE
* RATE AND DIRECTION OF CONTAMINANT MIGRATION
* CHANGES IN CONTAMINANT CONCENTRATIONS OR DISTRIBUTION OVER TIME
* EFFECTS OF ANY MODIFICATIONS TO THE ORIGINAL REMEDIAL ACTION.

OTHER ITEMS TO BE SPECIFIED IN THE PERFORMANCE MONITORING PLAN INCLUDE:

* MONITORING OF CONCENTRATIONS OF INFLUENT AND EFFLUENT TO THE AIR STRIPPER AND CATALYTIC OXIDATION UNITS (INFLUENT WATER CONCENTRATION, AND EFFLUENT WATER AND AIR CONCENTRATIONS) SO AS TO MEET AIR EMISSION STANDARDS

* CONCENTRATIONS OF CONTAMINANTS IN GROUND WATER TO BE REINJECTED, SO AS TO COMPLY WITH UIC REQUIREMENTS FOR REINJECTED GROUND WATER.

SOILS

AREA OF ATTAINMENT

THE AREA OF ATTAINMENT FOR THE SOIL REMEDIATION SHALL BE THE ENTIRE AREA WITHIN CSC OU1 WITH SOIL CONCENTRATIONS EXCEEDING THE REMEDIATION LEVELS CITED IN SECTION VI, IRRESPECTIVE OF CSC AND IDCA PROPERTY BOUNDARIES. THE ENTIRE VERTICAL SOIL COLUMN WILL BE USED TO DETERMINE WHERE REMEDIATION IS REQUIRED. THE ESTIMATED AREA REQUIRING REMEDIATION IS SHOWN IN FIGURE 8. THIS AREA MAY BE REVISED BASED ON SOIL SAMPLING DURING RD/RA.

RESTORATION TIME FRAME

THE RESTORATION TIME FRAME FOR THIS REMEDIAL ACTION IS ESTIMATED TO BE APPROXIMATELY 150 DAYS.

PERFORMANCE STANDARDS

SPECIFIC PERFORMANCE STANDARDS, USED TO ENSURE ATTAINMENT OF THE REMEDIAL ACTION OBJECTIVES FOR SOIL, ARE:

1) REDUCE CONTAMINANT CONCENTRATIONS IN SOIL WITHIN THE AREA OF ATTAINMENT TO THE SOIL REMEDIATION LEVELS SPECIFIED IN SECTION VI.

2) MEET ALL ARARS IDENTIFIED IN THIS ROD FOR THE REMEDIATION OF SOIL, INCLUDING REQUIREMENTS FOR AIR EMISSIONS MONITORING.

3) THE REMEDIAL ACTION SHALL BE CONSIDERED COMPLETE AFTER THE SOIL REMEDIATION LEVELS HAVE BEEN ATTAINED IN ALL COMPLIANCE SOIL BORINGS AND SURFACE SOIL SAMPLES. ATTAINMENT OF THE REMEDIAL ACTION OBJECTIVES FOR THE INCIDENTAL INGESTION AND DIRECT CONTACT PATHWAYS MUST BE VERIFIED THROUGH CHEMICAL ANALYSIS OF THE UPPER SIX INCHES OF SOIL. ATTAINMENT OF THE REMEDIAL ACTION OBJECTIVES FOR THE PATHWAY OF MIGRATION OF SOIL CONTAMINANTS INTO GROUND WATER MUST BE VERIFIED BY SAMPLING THE SOIL CONCENTRATIONS AREALLY (FROM A NUMBER OF BOREHOLES) AND VERTICALLY (FROM A NUMBER OF SAMPLES COLLECTED FROM A SINGLE BOREHOLE). THE EXTRACTION SYSTEM SHALL CONTINUE TO OPERATE UNTIL REMEDIATION LEVELS HAVE BEEN REACHED IN ALL COMPLIANCE SOIL BORINGS AND SURFACE SOIL SAMPLES (UPPER SIX INCHES OF SOIL). ATTAINMENT OF THE SOIL REMEDIATION LEVELS WILL BE VERIFIED BY CHEMICAL ANALYSIS OF SOIL SAMPLES, NOT BY SOIL HEADSPACE

ANALYSIS. AFTER THE REMEDIAL ACTION IS COMPLETE, THERE MAY BE ADDITIONAL MONITORING REQUIRED BY EPA, AT EPA'S SOLE DISCRETION.

THE SOIL BORINGS AND SURFACE SOIL SAMPLES TO BE USED FOR COMPLIANCE MONITORING FOR SOIL WILL BE SPECIFIED DURING REMEDIAL DESIGN, AND WILL, AT A MINIMUM, INCLUDE BORINGS AND SAMPLES WITHIN AND SURROUNDING THE AREA OF ATTAINMENT. THE BORINGS SHALL BE DRILLED TO THE WATER TABLE, AT A MINIMUM, AS APPROVED BY EPA DURING RD. ANY STATISTICAL METHODS TO AVERAGE SOIL CONCENTRATION AREALLY OR VERTICALLY WITHIN A BOREHOLE SHALL BE SPECIFIED DURING RD/RA. THE EPA GUIDANCE DOCUMENT ENTITLED "METHODS FOR EVALUATING THE ATTAINMENT OF CLEANUP STANDARDS--VOLUME 1: SOILS AND SOLID MEDIA" (EPA 230/02-89-042) WILL BE CONSULTED WHEN ESTABLISHING THE PERFORMANCE AND COMPLIANCE SAMPLING PROGRAM, DESCRIBED IN THE FOLLOWING SUBSECTION.

IT MAY BECOME APPARENT DURING IMPLEMENTATION OR OPERATION OF THE SOIL REMEDIATION SYSTEM THAT CONTAMINANT LEVELS HAVE CEASED TO DECLINE OR ARE REMAINING CONSTANT AT LEVELS HIGHER THAN THE REMEDIATION LEVEL. IN SUCH A CASE, THE SYSTEM'S PERFORMANCE STANDARDS AND OR THE REMEDY MAY BE REEVALUATED. IF NEW EXTRACTION OR REMEDIATION TECHNOLOGIES BECOME AVAILABLE IN THE FUTURE WHICH WOULD SIGNIFICANTLY IMPROVE THE REMEDIATION PROCESS (ALLOW ATTAINMENT OF REMEDIATION LEVELS WHICH WERE NOT PREVIOUSLY ATTAINABLE, OR EXPEDITE THE CLEANUP), THE REMEDY WILL BE REEVALUATED IN LIGHT OF THE NEW INFORMATION.

THE SOIL REMEDIATION SYSTEM'S PERFORMANCE WILL BE CAREFULLY MONITORED ON A REGULAR BASIS AND ADJUSTED AS WARRANTED BY THE PERFORMANCE DATA COLLECTED DURING OPERATION.

4) THE PRP SHALL USE BEST EFFORTS TO REMEDIATE THE SOIL IN A TIMELY MANNER. "BEST EFFORTS" SHALL INCLUDE IMPLEMENTATION OF THE REMEDY IN COMPLIANCE WITH THE ROD, CONSENT DECREE AND SOW, TO MAXIMIZE PERFORMANCE OF THE REMEDIAL ACTION TO ACHIEVE THE PERFORMANCE STANDARDS AS QUICKLY AS POSSIBLE.

PERFORMANCE AND COMPLIANCE SAMPLING PROGRAM

A SAMPLING PROGRAM FOR MONITORING THE REMEDIAL ACTION PERFORMANCE AND FOR DETERMINING COMPLIANCE WITH THE PERFORMANCE STANDARDS SHALL BE IMPLEMENTED DURING THE REMEDIAL ACTION. THIS PROGRAM WILL BE DEVELOPED DURING REMEDIAL DESIGN AND SHALL INCLUDE, AT A MINIMUM, THE FOLLOWING: LOCATIONS OF PERFORMANCE MONITORING POINTS WITHIN THE SOIL VAPOR EXTRACTION SYSTEM; LOCATIONS OF COMPLIANCE MONITORING BOREHOLES TO BE DRILLED AFTER REMEDIATION IS BELIEVED TO BE COMPLETE, TO CONFIRM THAT REMEDIATION LEVELS HAVE BEEN REACHED; FREQUENCY OF MONITORING OF THE PERFORMANCE OF THE SVE SYSTEM, ANALYTICAL PARAMETERS (FOCUSING ON COCS, WITH POSSIBLE USE OF INDICATOR CHEMICALS), ANALYTICAL METHODS FOR LABORATORY AND FIELD CHEMICAL ANALYSIS (WITH POSSIBLE USE OF NON-CLP ANALYSIS), FIELD SAMPLING METHODS, AND STATISTICAL METHODS FOR EVALUATING DATA. THE PERFORMANCE AND COMPLIANCE SAMPLING PROGRAM WILL BE SPECIFIED IN THE RA WORKPLAN, AND MAY BE MODIFIED DURING THE RA.

OTHER ITEMS TO BE SPECIFIED IN THE PERFORMANCE MONITORING PLAN INCLUDE:

MONITORING OF CONCENTRATIONS OF INFLUENT AND EFFLUENT AIR INTO AND OUT OF THE CATALYTIC OXIDATION UNIT.

#SD
X. STATUTORY DETERMINATIONS

EPA'S PRIMARY RESPONSIBILITY AT SUPERFUND SITES IS TO SELECT REMEDIAL ACTIONS THAT ARE PROTECTIVE OF HUMAN HEALTH AND THE ENVIRONMENT. CERCLA

ALSO REQUIRES THAT THE SELECTED REMEDIAL ACTION FOR A SITE COMPLY WITH APPLICABLE OR RELEVANT AND APPROPRIATE ENVIRONMENTAL STANDARDS ESTABLISHED UNDER FEDERAL AND STATE ENVIRONMENTAL LAWS, UNLESS A WAIVER IS GRANTED. THE SELECTED REMEDY MUST ALSO BE COST-EFFECTIVE AND UTILIZE PERMANENT TREATMENT TECHNOLOGIES OR RESOURCE RECOVERY TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICABLE. THE STATUTE ALSO CONTAINS A PREFERENCE FOR REMEDIES THAT INCLUDE TREATMENT AS A PRINCIPAL ELEMENT. THE FOLLOWING SECTIONS DISCUSS HOW THE SELECTED REMEDY FOR THE CSC OU1 SITE MEETS THESE STATUTORY REQUIREMENTS.

PROTECTION OF HUMAN HEALTH AND ENVIRONMENT

IN ORDER TO MEET THE REMEDIAL OBJECTIVES OUTLINED PREVIOUSLY, THE RISK ASSOCIATED WITH EXPOSURE TO THE CONTAMINATED SOIL AND GROUNDWATER MUST FALL WITHIN THE ACCEPTABLE RISK FOR CARCINOGENS. ATTAINMENT OF SOIL AND GROUNDWATER REMEDIATION LEVELS DESCRIBED PREVIOUSLY IN SECTION VI WILL ASSURE THAT SITE RISK FALLS WITHIN THIS RANGE. EPA EXPECTS THAT CONTAMINANTS WILL BE REDUCED TO ACCEPTABLE LEVELS IN 150 DAYS FOR THE SOIL, 6 YEARS FOR GROUNDWATER IN THE PLUME AREA (BETWEEN SAND CREEK AND EAST 48TH AVENUE) AND 13 YEARS FOR GROUNDWATER IN THE SOURCE AREA (SOUTH OF EAST 48TH AVENUE). OF ALL THE ALTERNATIVES EVALUATED FOR CSC OU1, THE SELECTED ALTERATIVE PROVIDES THE BEST PROTECTION TO HUMAN HEALTH IN THE LEAST AMOUNT OF TIME. NO UNACCEPTABLE SHORT-TERM RISKS OR CROSS-MEDIA IMPACTS WOULD RESULT THROUGH IMPLEMENTATION OF THIS REMEDY.

ATTAINMENT OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS OF ENVIRONMENTAL LAWS

ALL ARARS WOULD BE MET BY THE SELECTED REMEDY.

CHEMICAL-SPECIFIC ARARS

THE SELECTED REMEDY WOULD ACHIEVE COMPLIANCE WITH CHEMICAL-SPECIFIC ARARS RELATED TO THE ALLUVIAL GROUNDWATER WITHIN THE CSC OU1 AREA. THE RELEVANT AND APPROPRIATE REQUIREMENTS INCLUDE FEDERAL AND STATE PRIMARY DRINKING WATER STANDARDS ESTABLISHED BY THE SAFE DRINKING WATER ACT. SOME CONTAMINANTS OF CONCERN IDENTIFIED FOR CSC OU1 HAVE MCLS. MCLS HAVE BEEN PROPOSED FOR THE MAJORITY OF THE REMAINING CONTAMINANTS OF CONCERN IDENTIFIED FOR THIS ROD AS TBCS. CONCENTRATION OF COCS AT THE CSC OU1 SITE WOULD BE REDUCED BELOW MCLS OR PROPOSED MCLS BY IMPLEMENTATION OF ALTERNATIVE 5.

VINYL CHLORIDE EMISSIONS FROM THE AIR STRIPPING TREATMENT SYSTEM WILL BE MONITORED AND IF REQUIRED, CONTROLS WOULD BE IMPLEMENTED TO ENSURE COMPLIANCE WITH NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS (40 CFR PART 61.60). AT PRESENT IT IS NOT EXPECTED THAT CONSTITUENTS FOR WHICH STANDARDS HAVE BEEN ESTABLISHED FOR THE COLORADO AIR QUALITY CONTROL ACT (CRS-25-7-101-2) WILL BE EMITTED. IN THE UNLIKELY EVENT THAT THESE CONSTITUENTS ARE PRODUCED, THE NECESSARY CONTROLS WOULD BE IMPLEMENTED IN ORDER FOR THE EMISSIONS TO COMPLY WITH THE REGULATIONS. PREDICTED AIR EMISSION CONCENTRATIONS FOR THE PLUME AREA IN THE OU1 FS ARE WITHIN ACCEPTABLE LEVELS BASED ON AN ASSESSMENT CONDUCTED IN THE FS. THESE ESTIMATES ARE BASED ON GENERALIZED ASSUMPTIONS WHICH CANNOT BE VERIFIED UNTIL THE FINAL LOCATION OF THE AIR STRIPPING UNIT IS IDENTIFIED. RISKS ASSOCIATED WITH AIR STRIPPING OPERATIONS FOR THE PLUME AREA WILL BE REEVALUATED BASED ON THE IDENTIFICATION OF A SPECIFIC LOCATION FOR THE AIR STRIPPING UNIT DURING REMEDIAL DESIGN. IMPLEMENTATION OF AIR EMISSION CONTROLS AND/OR EMISSION LIMITATIONS MAY BE REQUIRED PENDING THAT ASSESSMENT.

ACTION-SPECIFIC ARARS

THE SELECTED REMEDY WOULD COMPLY WITH ACTION-SPECIFIC ARARS FOR

INJECTION OF TREATED WATER BACK INTO THE GROUNDWATER AS SET FORTH IN STATE OF COLORADO REGULATIONS 5 CCR 1002-3 SEC. 10.1.0, 5 CCR 1002-2, SEC. 6.1.0 AND 6 CCR 1007-3 SEC. 100.21(B), FEDERAL UIC PROGRAM 40 CFR 144-147 AND RCRA SEC. 3020.

EPA POLICY (APPLICABILITY OF LAND DISPOSAL RESTRICTIONS TO RCRA AND CERCLA GROUNDWATER TREATMENT INJECTION SUPERFUND MANAGEMENT REVIEW: RECOMMENDATION NO. 26 OSWER DIRECTIVE NO. 9234.1-06, DECEMBER 27, 1989) IS THAT UIC RULES TAKE PRECEDENCE OVER LDRS FOR INJECTION OF HAZARDOUS WASTE INTO THE GROUNDWATER. THEREFORE, FOR INJECTION OF THE TREATED WATER, THE LDRS ARE NOT RELEVANT AND APPROPRIATE. HOWEVER, AS NOTED PREVIOUSLY, UIC REGULATIONS ARE APPLICABLE TO THIS ACTION.

AS DISCUSSED ABOVE, LAND DISPOSAL RESTRICTIONS ARE NOT APPLICABLE TO THE GROUNDWATER INJECTION ASPECTS OF THE SELECTED REMEDY. INSTEAD, RCRA SECTION 3020 APPLIES TO REINJECTION OF TREATED GROUNDWATER INTO CLASS IV INJECTION WELLS DURING CERCLA RESPONSE ACTIONS. SINCE THE GOAL IS TO CLEAN UP GROUNDWATER TO DRINKING WATER LEVELS, HEALTH BASED DRINKING WATER STANDARDS (MCLS), RATHER THAN LAND DISPOSAL RESTRICTIONS, ARE RELEVANT AND APPROPRIATE CLEAN UP STANDARDS.

FEDERAL AND STATE OF COLORADO REQUIREMENTS PERTAINING TO AIR EMISSIONS WILL BE MET WITH REGARD TO AIR STRIPPING OPERATIONS. THESE INCLUDE COLORADO AIR QUALITY REGULATIONS 1,2, 3 AND 8 (FOR VINYL CHLORIDE). THE SPECIFIC ACTIONS REGULATED AND THE SPECIFIC REGULATORY CITATIONS ARE PRESENTED IN APPENDIX B.

LOCATION SPECIFIC ARARS
THE SELECTED REMEDY WOULD ADDRESS AND COMPLY WITH ALL LOCATION-SPECIFIC ARARS FOR PRESERVATION AND PROTECTION OF THE SAND CREEK RIVER FLOODPLAIN ACCORDING TO REQUIREMENT OF 40 CFR 6.3022 AND PROTECTION OF SITE WETLANDS WITHIN THE CSC OU1 AREA.

COST EFFECTIVENESS

EPA BELIEVES THE SELECTED REMEDY IS COST-EFFECTIVE IN MITIGATING THE PRINCIPAL RISK POSED BY CONTAMINATED GROUNDWATER WITHIN A REASONABLE PERIOD OF TIME. SECTION 300.430(F)(II)(D) OF THE NCP REQUIRES EPA TO EVALUATE COST-EFFECTIVENESS BY COMPARING ALL THE ALTERNATIVES WHICH MEET THE THRESHOLD CRITERIA: PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT AND THE ATTAINMENT OF ARARS, AGAINST THREE ADDITIONAL BALANCING CRITERIA: LONG-TERM EFFECTIVENESS AND PERMANENCE; REDUCTION OF TOXICITY, MOBILITY OR VOLUME THROUGH TREATMENT; AND SHORT-TERM EFFECTIVENESS. THE SELECTED REMEDY MEETS THESE CRITERIA AND PROVIDES FOR OVERALL EFFECTIVENESS IN PROPORTION TO ITS COSTS. THE SELECTED REMEDY IS APPROXIMATELY THE SAME COST AS ALTERNATIVE NO. 3, HOWEVER, IT WILL ACHIEVE GROUNDWATER REMEDIATION LEVELS IN APPROXIMATELY ONE THIRD THE TIME REQUIRED FOR ALTERNATIVE NO. 3.

THEREFORE, THE SELECTED REMEDY IS COST-EFFECTIVE AS DEFINED IN THE NCP. THE ESTIMATED COST FOR THE SELECTED REMEDY IS APPROXIMATELY $2,081,000.

UTILIZATION OF PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT TECHNOLOGIES OR RESOURCE RECOVERY TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICABLE

EPA BELIEVES THE SELECTED REMEDY REPRESENTS THE MAXIMUM EXTENT TO WHICH PERMANENT SOLUTIONS AND TREATMENT TECHNOLOGIES CAN BE UTILIZED IN A COST-EFFECTIVE MANNER FOR CSC OU1. OF THOSE ALTERNATIVES THAT ARE PROTECTIVE OF HUMAN HEALTH AND THE ENVIRONMENT AND COMPLY WITH ARARS,

EPA HAS DETERMINED THAT THE SELECTED REMEDY PROVIDES THE BEST BALANCE OF TRADE-OFFS IN TERMS OF LONG-TERM EFFECTIVENESS AND PERMANENCE, REDUCTION

IN TOXICITY, MOBILITY OR VOLUME ACHIEVED THROUGH TREATMENT; SHORT-TERM EFFECTIVENESS; IMPLEMENTABILITY; AND COST, AND ALSO CONSIDERING THE STATUTORY PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT AND CONSIDERING STATE AND COMMUNITY ACCEPTANCE.

OF THE TWO ALTERNATIVES WHICH MEET THE THRESHOLD CRITERIA (ALTERNATIVE NOS. 3 AND 5), THE SELECTED REMEDY (ALTERNATIVE NO. 5) REDUCES TOXICITY, MOBILITY AND VOLUME OF THE CONTAMINANTS IN THE GROUNDWATER AND SOIL EQUALLY AS WELL AS ALTERNATIVE NO. 3. SHORT TERM EFFECTIVENESS WAS CRITICAL IN CHOOSING ALTERNATIVE NO. 5 DUE TO THE MUCH SHORTER REMEDIATION TIME FRAME.

PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT

THE SELECTED REMEDY SATISFIES THE STATUTORY PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT. IF POOLS AND POCKETS OF DNAPL ARE DETECTED, THEY WILL BE TREATED THROUGH EXTRACTION, AIR STRIPPING AND CATALYTIC OXIDATION. TREATMENT OF DNAPLS MAY REQUIRE THAT THE DNAPL BE DILUTED PRIOR TO TREATMENT. SURFICIALLY CONTAMINATED SOILS DO NOT POSE A SUFFICIENT RISK TO BE CONSIDERED A "PRINCIPAL THREAT".

#DSC
XI. DOCUMENTATION OF SIGNIFICANT CHANGES

NO SIGNIFICANT CHANGES

THE PROPOSED PLAN FOR OU1 OF THE CHEMICAL SALES COMPANY SITE WAS RELEASED FOR PUBLIC COMMENT ON FEBRUARY 28, 1991. THE PROPOSED PLAN IDENTIFIED ALTERNATIVE 5 AS THE PREFERRED ALTERNATIVE. EPA REVIEWED ALL WRITTEN AND VERBAL COMMENTS SUBMITTED DURING THE PUBLIC COMMENT PERIOD. UPON REVIEW OF THESE COMMENTS, IT WAS DETERMINED THAT NO SIGNIFICANT CHANGES TO THE REMEDY, AS IT WAS ORIGINALLY IDENTIFIED IN THE PROPOSED PLAN, WERE NECESSARY.

#TA

TABLE 3
SUMMARY OF CANCER RISKS BY PATHWAY FOR
POTENTIAL RECEPTORS AT THE CHEM SALES OU1 SITE

EXPOSURE PATHWAY	CURRENT WORKERS	CURRENT RESIDENTS
GROUNDWATER PATHWAYS		
INGESTION OF GROUNDWATER	4 X (10-2)	3 X (10-4)
INHALATION OF VOCS DURING SHOWERING	2 X (10-2)	4 X (10-4)
DIRECT CONTACT WITH VOCS DURING SHOWERING	3 X (10-6)	1 X (10-7)
TOTAL RISK FOR GROUNDWATER PATHWAYS	6 X (10-6)	7 X (10-4)

	FUTURE RESIDENTS	FUTURE CHILDREN
GROUNDWATER PATHWAYS		
INGESTION OF GROUNDWATER	1 X (10-1)	NE
INHALATION OF VOCS DURING SHOWERING	9 X (10-2)	NE
DIRECT CONTACT WITH VOCS DURING SHOWERING	8 X (10-6)	NE
TOTAL RISK FOR GROUNDWATER PATHWAYS	1 X (10-1)	NE

	CURRENT WORKERS	CURRENT RESIDENTS
SOIL PATHWAYS		
DIRECT CONTACT WITH SURFACE SOIL (DERMAL ABSORPTION)	2 X (10-6)	NE
INCIDENTAL INGESTION OF SURFACE SOIL	7 X (10-7)	NE
TOTAL RISK FOR SOIL PATHWAYS	2 X (10-6)	NE
INHALATION OF VOCS IN OUTDOOR AMBIENT AIR	5 X (10-5)	NE
TOTAL RISK FOR AIR PATHWAYS	5 X (10-5)	NE
TOTAL RISK	6 X (10-2)	7 X (10-4)

	FUTURE RESIDENTS	FUTURE CHILDREN
SOIL PATHWAYS		

DIRECT CONTACT WITH SURFACE SOIL (DERMAL ABSORPTION)	6 X (10-6)	1 X (10-4)
INCIDENTAL INGESTION OF SURFACE SOIL	7 X (10-7)	9 X (10-5)
TOTAL RISK FOR SOIL PATHWAYS	6 X (10-6)	1 X (10-4)
INHALATION OF VOCS IN OUTDOOR AMBIENT AIR	NE	4 X (10-5)
TOTAL RISK FOR AIR PATHWAYS	NE	4 X (10-3)
TOTAL RISK	2 X (10-1)	3 X (10-4)

NE = NOT EVALUATED

TABLE 4
SUMMARY OF NONCARCINOGENIC RISKS (HAZARD INDICES) BY PATHWAY
FOR POTENTIAL RECEPTORS AT THE CHEM SALES OU1 SITE

	CURRENT WORKERS	CURRENT RESIDENTS
GROUNDWATER PATHWAYS		
INGESTION OF GROUNDWATER	62	0.3
INHALATION OF VOCS DURING SHOWERING	13	0.2
DIRECT CONTACT WITH VOCS DURING SHOWERING	0.006	0.00005
TOTAL RISK FOR GROUNDWATER PATHWAYS	75	0.5

	FUTURE RESIDENTS	FUTURE CHILDREN
GROUNDWATER PATHWAYS		
INGESTION OF GROUNDWATER	84	NE
INHALATION OF VOCS DURING SHOWERING	26	NE
DIRECT CONTACT WITH VOCS DURING SHOWERING	.01	NE
TOTAL RISK FOR GROUNDWATER PATHWAYS	110	NE

	CURRENT WORKERS	CURRENT RESIDENTS
SOIL PATHWAYS		
DIRECT CONTACT WITH SURFACE SOIL (DERMAL ABSORPTION)	0.0001	NE
INCIDENTAL INGESTION OF SURFACE SOIL	0.003	NE
TOTAL RISK FOR SOIL PATHWAYS	0.003	NE
INHALATION OF VOCS IN OUTDOOR AMBIENT AIR	0.007	NE
TOTAL RISK FOR AIR PATHWAYS	0.007	NE
TOTAL HAZARD INDEX	75	0.5

	FUTURE RESIDENTS	FUTURE CHILDREN
SOIL PATHWAYS		
DIRECT CONTACT WITH SURFACE		

SOIL (DERMAL ABSORPTION)	0.3	3.9
INCIDENTAL INGESTION OF SURFACE SOIL	.003	0.02
TOTAL RISK FOR SOIL PATHWAYS	0.3	3.9
INHALATION OF VOCS IN OUTDOOR AMBIENT AIR	NE	0.01
TOTAL RISK FOR AIR PATHWAYS	NE	0.01
TOTAL HAZARD INDEX	110	4.0

NE = NOT EVALUATED

TABLE 5
GROUNDWATER REMEDIATION LEVEL

CHEMICAL	STANDARD(MG/1)	COMMENT
DCA	.005	(10-6) RISK LEVEL,
DCE	.007	MCL (40 CFR 141)
TCA	.200	MCL (40 CFR 141)
PCE	.005	MCL, (56 FR NO. 20, 1/30/91)
TCE	.005	MCL (40 CFR 141)
1,2 DCE	.070	COLORADO BASIC STANDARD FOR GROUNDWATER, EFFECTIVE SEPTEMBER 30, 1989
VC	.002	MCL (40 CFR 141)
CARBON TETRACHLORIDE	.005	MCL (40 CFR 141)
METHYLENE CHLORIDE	.010	(10-6) RISK LEVEL